# THE INTERREGIONAL EFFECTS OF CANADIAN TARIFFS AND TRANSPORTATION POLICY

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UNIVERSITY OF TORONTO PRESS
Toronto Buffalo London

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Printed in Canada

ISBN 0-8020-6630-5

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Printed on acid-free paper


**Canadian Cataloguing in Publication Data**

Melvin, James R.

The interregional effects of Canadian tariffs and transportation policy with special reference to Ontario

Bibliography: p.
ISBN 0-8020-6630-5

1. Tariff - Canada. 2. Transportation and state - Canada. 3. Canada - Economic conditions - Regional disparities. 4. Canada - Commercial policy. 5. Ontario - Commercial policy. I. Title.

HF1766.M44 1987 382.7'0971 C86-095098-0

# Contents

# Preface

Although Canada is a nation for which both international trade and regional concerns are of paramount importance for economic policy, there has been little attention paid to the interaction between trade and regional policy. The research reported here is a preliminary attempt to bring these two branches of economic analysis together. Undoubtedly some readers will not agree that my approach to this problem is the appropriate one, or will feel that the implications which have been drawn from the analysis are incorrect or uninteresting. Even so I will feel that the project has been well worth the time and effort if it generates new ideas and further research on the important issue of the implications of trade policy for a regional economy. The fact that such an obviously important issue has received almost no attention in Canada must be regarded as a major shortcoming of Canadian economic research.

The research for this book was supported by the Ontario Economic Council, and the final draft of the manuscript was in preparation when the council was disbanded. I am indebted to Tom Courchene and Kevin Dowd (formerly of the council) for arranging for an alternative publication outlet, and I wish to express my appreciation to the University of Toronto Press for taking over the project in mid-stream.

Several people read part or all of the manuscript and made useful comments. I am particularly indebted to Tom Courchene, Irwine Diewert, and Ron Jones for detailed suggestions. My wife Barb proofread the entire manuscript several times, and my son Robert drew all the diagrams; the final version owes much to their contributions.

# THE INTERREGIONAL EFFECTS OF CANADIAN TARIFFS AND TRANSPORTATION POLICY

# 1

# Introduction

There has always been a good deal of attention paid to the issues of trade and trade policy in Canada both by academics and in the popular press. In recent years there has been much discussion about the possibility of reducing trade barriers with the United States. The possibility of sectoral free trade occupied the spotlight for some years, and more recently attention has turned to the possibility of complete free trade. A variety of studies have been carried out by academic economists, most of which have concluded that moving towards freer trade with the United States would improve welfare for Canadians. The first major study in this area was Wonnacott and Wonnacott (1967), and the most recent full general equilibrium analysis was done by Harris (1984a).

The theoretical argument that free trade is superior to restricted trade for a small open economy is well understood and is now well treated in even introductory economics texts. The gains-from-trade theorem, initially proved by Paul Samuelson (1939), may well be the best-known proposition in all of economic theory.

Given the preponderance of evidence in support of free trade one might expect that everyone would be supportive of a move to less restrictive trade with the United States, and that government officials would be working unceasingly for the removal of trade barriers. Such has not been the case, however, for a number of groups have opposed any moves towards the removal of trade barriers. That some would oppose free trade is perfectly understandable. The benefits associated with free trade require that countries specialize in those commodities in which they have a comparative advantage, and if they were to do this some industries would contract and some might disappear. In the short run the factors of production employed in declining industries may well be

harmed by these adjustments to a free trade equilibrium. It is also well known that any change in the terms of trade facing an economy will improve the welfare of some factors but reduce the welfare of others. This is the Stolper-Samuelson theorem from international trade theory. Thus for a country that is relatively well endowed with capital the movement to free trade will increase the real and relative return to capital but will reduce the real and relative wage rate. Unless labourers can be assured that they will receive some of the benefits, they would certainly oppose a move to free trade.

Other groups have traditionally opposed free trade as well, however. In the past some Canadian provinces have not been whole-hearted supporters of free trade, and at present the Ontario government is approaching the free-trade option with extreme caution. The implicit argument seems to be that while free trade might be beneficial to the country as a whole it may not be beneficial for the province of Ontario. This point of view is, of course, just a corollary of the view that the industrialized areas of Canada, and in particular Ontario, have been the benefactors of the Canadian tariff structure. This has long been the view of the Western and Maritime provinces and now seems to be the view of Ontario as well. The proposition that some provinces have benefited from tariffs raises the issue of whether regions will fare differently when policy changes are introduced at the international level and, if so, what differences among regions would give rise to such a result. Although this is a particularly important issue for a country such as Canada with distinct regions, it has received almost no attention in the economic literature. A principal goal of this study is to initiate a discussion of international trade policy in the context of a country that has regions - regions that are distant from one another and that differ in factor endowments or size and the structure of production.

## 1. THE STUDY IN PERSPECTIVE

The importance of international trade for the Canadian economy and for the economy of the province of Ontario is obvious, and academic economists in Canada have made notable contributions to international trade theory and to the analysis of the empirical consequences of free trade for the Canadian economy. Canada is also a distinctive regional country, and this fact, too, has not gone unnoticed by

Canadian economists. Canadian public policy has paid a great deal of attention to regional disparities in the Canadian economy, and there is a significant literature in this area. What is somewhat surprising is that there is almost no research that combines these two branches of economic analysis. The consequences of different trade policies for a regional economy have received almost no attention by economists in Canada or elsewhere. Part of the reason for the neglect probably stems from the fact that much of modern regional economics is not concerned with interactions among regions (what one might call interregional analysis) but with the spatial economic activity of a region itself (what might be called the economics of a region). While both of these fields of inquiry are worth while and deserving of attention the former seems of particular importance for policy discussions in a small open economy such as Canada. It is precisely this area that has been largely neglected in the regional economics literature.

A trade theorist, if asked to set up a model that encompasses both international trade and distinctly different regions within the home country, would almost certainly begin by constructing a simple general-equilibrium model that captured these features. Curiously enough this approach does not seem to have been used in the regional economics literature. A recent survey of the tools of regional economic analysis by Richardson (1985a), which contains over 100 references, makes no mention of this simple theoretical approach to regional analysis. The neglect of the standard two-sector model in regional economics literature is surprising, for the approach promises to be very useful in analysing a wide variety of regional economic questions. In Canada, in particular, there has been much discussion over the years about regional disparities but almost no analysis of why such disparities exist. Of even more fundamental importance is the issue of whether the disparities are something which should be corrected or whether they are simply the reflection of different equilibrium conditions in different regions. Also of importance is the issue of whether disparities are associated with fundamental differences in economic structure or whether they are the consequences of inappropriate government policy at either the federal or provincial levels.

These and other issues can be profitably examined using the two-sector general-equilibrium model first developed by international trade theorists and now used in a variety of

other areas. A number of interesting issues can be examined using this general-equilibrium approach. Melvin (1985a), for example, has investigated the consequences when individuals in different regions have different preferences. It is shown that even when preferences represent the only difference between two regions several of the standard propositions from international trade theory require substantial revision. A brief summary of some of these results will be given in Chapter 2.

Another area amenable to this approach is the investigation of the consequences of different minimum wages in different regions, or of differences in the degree of unionization. With a general-equilibrium model it can be shown that if regions differ in terms of legislated minimum wages then in equilibrium one would expect the rates of unemployment to differ, the region with the highest minimum wage being the region with the highest level of unemployment. It can also be shown that in certain circumstances high wage rates and high rates of unemployment could be expected to exist in the same region. Some preliminary work in this area has been done by Melvin (1985c).

Of particular interest for the present study are the consequences of international trade for an economy made up of regions that are separated by substantial distances. This is a broad area, and a wide variety of models could be constructed and a number of questions investigated. In the most general case where the economic behaviour of a country could change the world terms of trade one could investigate the effects of domestic policy, at either the regional or the national level, on the economies of the different regions through terms-of-trade effects. The present study abstracts from these issues by assuming that the country, and therefore both regions, is small relative to the rest of the world. Thus it is assumed throughout that the world terms of trade are given and are not affected by domestic policy actions. To simplify the analysis it is assumed throughout that there are only two regions. It is not difficult to generalize the results to include more regions.

Issues that could be investigated even in the small-country model would include exogenous growth in factor supplies for the economy as a whole or for individual regions, the effects of different tax policies, the consequences of assuming that some sectors are characterized by imperfect competition or the existence of monopolies, the consequences of differing production functions either between regions or between

countries, or a variety of other issues often considered in the international trade literature. The analysis of this study focuses on the issue of tariffs and their relationship to transportation costs, but pays attention to related policy instruments such as commodity taxation.

## 2. TARIFFS AND TRANSPORTATION

As has been suggested, we confine our attention to a small open economy and concentrate on the interaction of tariffs and transportation costs. Within this framework a number of models are considered. In Chapter 3 we begin with an analysis of the Heckscher-Ohlin model, which assumes that the basic difference between regions is in the endowments of the factors of production, capital, and labour. It is assumed that production functions of the regions are identical, and it is initially assumed that both production functions exhibit constant returns to scale. In order to focus attention on the effect of endowment differences it is also assumed that regional preferences are identical and homogeneous.

The Heckscher-Ohlin model is clearly long-run in nature for it assumes complete mobility of all factors of production between the two industries. In many situations, however, it is more relevant to suppose that some factors of production are unable to move between sectors. To analyse this situation we consider the specific-factor model, which assumes that two commodities are each produced using two factors of production, but that only one of these factors is mobile between the two industries. A number of interpretations of this model are possible. It can be interpreted as a short-run counterpart of the Heckscher-Ohlin model where capital is assumed fixed in place. This is the interpretation followed here, for it allows an easy comparison with the results derived from the Heckscher-Ohlin model, and provides a comparison of the long-run and short-run effects of various policy changes.

Both of the models described above assume constant returns to scale. It is generally believed that one of the principal sources of gains from trade for the Canadian economy is returns to scale, and to capture these effects a model in which increasing returns to scale are assumed is analysed in Chapter 5. With increasing returns to scale a variety of different models can be considered. For example, it can be assumed that there are increasing returns in all sectors of the economy, in which case specialization in

production is the expected result. Alternatively it could be assumed that while there are increasing returns to scale in some sectors there are constant returns to scale in others. This assumption will generally allow the production of both commodities in both regions, at least for some price ratios. Both of these versions of the increasing-returns-to-scale model are considered.

A feature that distinguishes these models from traditional trade analysis is the specific recognition that there are transportation costs between regions. Indeed, to focus attention on interregional transportation cost it is assumed that transportation costs between both regions and the rest of the world are zero and that the *only* transportation costs in the model are those between the two regions. It should be noted that this simplifying assumption is not crucial to most of the analysis but only serves to simplify the discussion.

In all the models attention is focused on the consequences, for the economy and for both regions, of specific policy actions, particularly the imposition of tariffs and commodity taxes. As will be seen, if the two regions export different commodities in equilibrium, an assumption that seems quite realistic for the Canadian economy, then tariffs have different effects on the regions. The effects of commodity taxes are considered because of the presumption from traditional international trade analysis that tariffs and commodity taxes can, under certain circumstances, be seen as substitutes. This presumption is found not to be true in our regional model.

## 3. THE POLICY ISSUES

The assumption that regions are spatially separated with significant transportation costs between them provides a certain amount of isolation for the regions. In such a circumstance it is possible that exogenous changes faced by the economy, or policy actions by the federal government, may have different consequences for different regions depending on how they are separately affected. One effect that is studied is that of an exogenous change in the terms of trade, and the subsequent effects interregional transfers may have. It is found that tariffs have differential effects across regions, which means that a tariff beneficial to one region may be harmful to another. Perhaps of most significance is the fact that tariffs may generate interregional

trade - trade that would not have taken place in a perfectly competitive, free-trade situation. This trade will be shown to be harmful to the economy as a whole but may be beneficial to a specific region. It is also shown that tariffs can generate differences in regional factor payments and per capita incomes. An understanding of these results will be useful in formulating a provincial policy stance on tariffs and equalization-payment issues.

The introduction of the possibility of increasing returns to scale raises a variety of other issues. It is found, for example, that a principal determinant of whether a region will gain or lose from trade is the relative size of the region. These results will be important when analysing the position that a province should take on the free-trade question, particularly large provinces such as Ontario.

Other policy issues relate to the interactions among regions and to the interactions between regions and the federal government. It is found, for example, that in certain circumstances provincial governments can pursue policies that will almost entirely offset policies of the federal government. In terms of interprovincial relations it is found that interprovincial barriers to trade are not always undesirable, leading to the conclusion that in some circumstances more, rather than fewer, barriers to interprovincial trade may be appropriate.

## 4. PLAN OF THE STUDY

Chapter 2 considers some of the literature relevant to the present analysis. This task turns out to be difficult, for while there is very little literature directly related to the specific approach of this study, there is a huge volume of literature related to certain aspects of it. Chapter 3 provides the basic core of the analysis, by developing the perfectly competitive, constant-returns-to-scale model. The Heckscher-Ohlin theorem from international trade theory is heavily relied on. Chapter 4 considers a short-run version of the endowment model in which only labour is perfectly mobile between sectors. The specific-factor model is employed for this purpose. In Chapter 5 the assumption of constant returns to scale is relaxed, and a variety of models employing increasing returns to scale are considered. Chapter 6 draws together the principal conclusions from the study and analyses the policy implications for Ontario.

# 2

# Some related literature

The task of doing a survey of related literature for the present study is a difficult one, for while there has been virtually no research done on the specific topic to be considered there is an enormous volume of closely related literature. The principal concern of the study is the interaction between transportation costs and policy barriers to trade such as tariffs for a regional economy actively engaged in international trade. The broad focus is on the Canadian economy, with particular reference to the implications for the province of Ontario. The general equilibrium methodology employed has not, at least to our knowledge, been used to address this issue except in an earlier related paper by the author (Melvin 1985a).

But while the specific topic has not been addressed, the analysis spans a broad range of economic issues, all of which have been addressed extensively in the literature. The study deals with regional economics, which is an entire branch of the discipline in its own right. Transportation costs form an important part of our analysis, and this subject has received a good deal of attention, both as a separate discipline area and as a part of the more general analysis of regional policy. We are concerned with Canadian regional issues, and again one finds an extensive literature in this area, both on general issues and more specifically on the interaction among the various regions of the Canadian economy. Finally the study is concerned with the economic consequences of tariffs in a world in which there is international trade. Tariffs and trade are the subject of a voluminous literature.

It would be inappropriate and unfeasible to make any attempt at a systematic review of such a wide range of topics. In this chapter we will try to touch briefly on each

of these areas, more with a view to understanding why they do not provide us with the appropriate policy framework we seek rather than in an attempt to provide a systematic analysis of the conclusions they do provide.

The chapter will proceed as follows. We first comment briefly on regional economics as a theoretical discipline. We then discuss some aspects of the transportation literature. A brief analysis of some of the explicitly Canadian literature dealing with regional issues is then undertaken, and finally we provide some brief comments on the international trade literature, which forms the basic methodology for the analysis.

## 1. REGIONAL ECONOMICS

As was noted in Chapter 1 regional economics can be classified into two broad areas: the study of the economics of a region (spatial economics) and the interaction among regions (what might be called interregional economics). The former is concerned mainly with explanations of regional development and regional growth, and references are seldom made to interactions among regions or the role the regions play in a broader economy-wide structure. These models tend to be competing explanations of regional activity rather than to form parts of a comprehensive group of economic theorems or propositions that make up a unified discipline. In this classification would be included economic base models which, while identifying the importance of exports for a particular region, nevertheless do not explicitly introduce trade in a general equilibrium sense. There is usually heavy reliance on multipliers of a Keynesian variety. For a recent discussion of these models see Richardson (1985b).

Shift-share analysis is also often used as a device to explain changes in industrial development, but the analysis is very partial-equilibrium in nature and is often criticized as being ad hoc. Stevens and Moore (1980) provide a survey of many of the recent studies in this area. Gravity models are another technique that has been used to explain regional development and particularly the forces of agglomeration associated with central places. A general formulation of such models is provided by Alonso (1978). Again these models are very informal and ad hoc and generally provide no links with other regions or other countries. Growth-poles analysis could also be considered as an explanation of the development of a region although in this case the analysis is more

complex for no single explanation for regional development is provided. And while this approach has been used to compare the development of different regions, rarely is any interaction between these regions specifically modelled. There is also a wide variety of econometric and input-output models that are specifically developed for a region and generally have no specific interregional structure.

Models that are genuinely interregional in nature are difficult to find. There are, of course, the multiregional input-output models associated with Isard, which are developed for different regions and then integrated to produce the national economy. Recent examples include Isard and Anselin (1982) and Isard and Smith (1983). While these models are certainly interregional in nature they are very much black boxes in terms of the underlying theory, and they provide few insights into regional economic policy issues.

A general-equilibrium model with disaggregation at the regional level has been developed for the Australian economy by Dixon et al. (1977, 1978). In these studies industries are considered to be either local or national, and the consequences for various regions of different economic policies can be considered. While such studies are suggestive for the Canadian economy, the relative differences between international and national transportation costs for Australia and Canada suggest a much more important role for transportation costs in the Canadian context. There is no explicit introduction of transportation costs in the Dixon models. A variety of models of a regional nature have been constructed for the Canadian economy, but it seems more appropriate to consider these in Section 3 below.

Perhaps the most interesting aspect of regional models is not the methodology they use or the problems they address but rather the range of issues that are not considered and the theoretical techniques that are not generally employed. In a recent paper Richardson (1985a) has provided 'A Review of Techniques for Regional Policy Analysis', where he summarizes the various methodologies and techniques used by regional economists to analyse policy issues. It is noteworthy that except for input-output models no mention is made of general-equilibrium analysis. This statement is not a reflection on Richardson's paper, but simply an indication of the fact that general-equilibrium methodology does not seem to have become a part of the tool-kit of regional economists. This fact is all the more surprising when one notes that the study of international trade and the study of

interregional trade are not fundamentally different, and yet the techniques used in these two branches in the economics discipline are almost completely disjoint. A central feature of the present study is that it brings the general-equilibrium techniques of international economics to bear on the related problems of interregional trade and policy-related issues.

## 2. TRANSPORTATION COSTS

There is an extensive literature on transportation economics, most of which is partial-equilibrium in nature. It is not particularly relevant to the present analysis and therefore an exhaustive survey will not be undertaken. Some of the very simple transportation models are suggestive for some of the interregional trade issues, however, and we will therefore consider these briefly.

The simplest model assumes a natural resource or a factor of production at one location and a market for some final product that uses this resource as an input at another location. The resources used to produce the final product and the final product are both costly to transport. Production is carried out under conditions of constant returns to scale, and all other factors necessary for production are assumed readily available at either the resource location or the market or at any intermediate point. The problem is to find the cost-minimizing location for the firm. A variety of assumptions can be made about the transportation technology. Transportation cost can be assumed to be a linear or a decreasing function of distance. It is often assumed that there are positive terminal costs at both locations, and trans-shipment points can easily be introduced.

Figure 2.1 illustrates the geometrical solution of a simple version of this transportation problem. Here it is assumed that transportation costs are a linear function of distance and that positive terminal costs exist. The resource is assumed located at point R and the market at point M and the problem is to find the point between R and M (inclusive) where the total cost is minimized. This will be the optimal location for the firm. A unit of the resource is defined to be that quantity necessary for the production of one unit of the final product. Fixed coefficients in production are also assumed. With the terminal cost of a unit of the resource equal to r, the transportation cost per mile of the resource equal to $t_r$, and d the distance from R to the location of the firm, the total transportation cost

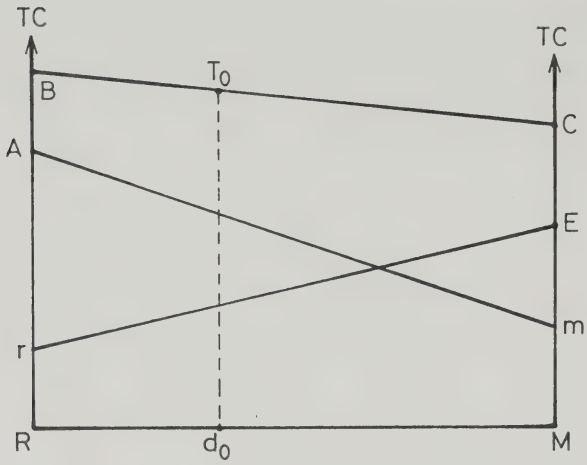


Figure 2.1

for moving a unit of the resource to any location will be given by

(1) $T_r = r + t_r d.$

With m the terminal cost per unit of output of the final product, $t_m$ the transportation cost per unit of output per mile, and D the distance between R and M, the total cost of transporting the final product to any point (D-d) between R and M is given by

(2) $T_m = m + t_m(D-d).$

The cost-minimizing location can be found algebraically from equations (1) and (2), but is more easily derived from Figure 2.1. Here r and m are the terminal costs and the slopes of rE and mA are the per-unit transportation costs of the resources and the final products respectively. The total production cost at any location will be the sum of the cost functions for the resource and the product, keeping in mind that if production takes place at one of the end-points only one terminal cost is required. Thus if the resource is transported to the market where production takes place the total production cost will be ME. If production takes place at the source of the resource and then is transported to the market the total cost will be RA. Alternatively suppose some intermediate location such as $d_0$ is chosen. Here total

transportation costs will be $T_0$, the vertical summation of the cost functions for the resource and the raw material. The total-cost function therefore is the discontinuous line ABCE, and it can be seen that in this example total cost is minimized at point E. Production will therefore take place at the market.

Several conclusions are immediate from this simple model. First it is clear that production will take place either at the site of the resource or at the market and never in between. Any intermediate location will require that both terminal costs r and m be undergone whereas at either R or M only one of these two must be incurred. It is also clear that both the terminal cost and the transportation costs are important determinants of the location of the firm. In particular, note that an increase in $t_r$ will increase the total cost of production at M and will make it more likely that production will remain at the source of the raw material.

Now suppose that the resource is wheat located in the West and that the market for flour, the final product, is located in the East. What variables determine where the flour will be milled? Clearly the higher the transportation cost of wheat the more likely it is that production will take place in the West. Looking at it the other way around, subsidies on the transportation of wheat will be expected to result in more processing taking place at the market in the East. Reductions in terminal costs, of course, will have the same effect. Thus government subsidies in the transportation sector for inputs such as wheat would be expected to result in more of the processing of the final products taking place at the market. This simple model helps explain the somewhat schizophrenic views held in Western provinces concerning the Crow's Nest Pass rate for grains. While the Crow's Nest Pass rate was a clear benefit to the farmers producing the wheat, it would be expected to reduce the level of processing of wheat products done in the wheat-producing provinces. Similar arguments obviously apply to transportation subsidies for any primary inputs.

While such transportation models are suggestive they are far too simplistic to provide specific policy recommendations for general-equilibrium questions. Note that in the model just described all prices, including the prices of factors of production, are assumed given exogenously. The production side is very simplistic and requires fixed-coefficient production functions if more than one factor of

production is to be included. There is no demand side and there are no factor endowment constraints. Indeed only the transportation sector is modelled, and even here the model is very simplistic. No transportation technology is specified, for example, and the transportation rates and terminal costs are assumed exogenously given.

Of course, much more sophisticated transportation models have been developed, and this discussion is not meant to suggest that transportation economics has not gone beyond these simple models. All transportation models do remain, however, very partial-equilibrium in nature, and do focus almost entirely on the transportation sector rather than building transportation into a more general model.

Although most discussions of international trade abstract from transportation costs, there has been some discussion of the importance of transportation for international trade. An early example is Moneta (1959), and in the Canadian context Munro (1969) has discussed the importance of transportation costs for trade liberalization in the Canadian economy. More recently Conlon (1983) has compared the relative effects of transportation costs and tariffs for the Australian and Canadian economies.

The Munro study provides some interesting information on the relative importance of transportation costs for the Canadian economy. He compares transportation costs and gross national product for the United States and Canada for the years 1940-65 and by comparing ton-miles per dollar of GNP in the two countries shows that Canada is more transport-intensive by a factor of from 25 per cent in 1950 to 61 per cent in 1964 with an average of 45 per cent over the 25-year period. In later chapters we will argue that transportation costs within Canada may well be greater than international transportation costs to the United States, and Munro's figures are consistent with our assumption of the importance of internal transportation costs for Canada.

Munro also provides some evidence on the absolute importance of transportation costs for international trade. He finds, for example, that the freight factor (freight costs as a proportion of product price) is on average 24 for shipments of lumber and plywood from Canada to the United States, although it can be as high as 42 for lumber shipped from Quesnel in the BC interior to Birmingham, Alabama.

A more recent analysis of the importance of transportation costs for Canadian industry has been carried out by Skoulas (1981). He uses an input-output methodology to

calculate the components of production cost and final consumer price associated with transportation. His calculations provide information on the importance of transportation costs for commodity prices in Canada, and we will therefore consider some of his results in more detail. Tables 1, 2, and 3 reproduce Skoulas's tables 2, 5, and 6.

The first column in Table 1 gives the direct and indirect transportation costs embodied in the production process itself. These are transportation costs associated with inputs and the indirect costs of resources and intermediate products embodied in these inputs. This component of transportation cost is part of the overall production cost for the industry. The ranges of these costs are given for primary and manufacturing industries, and these are calculated as a percentage of output valued in producer prices. For

TABLE 1
Range of average transportation charges in goods-producing industries, 1974

| Industry group | Industry output (direct and indirect transportation charges embodied in production cost as a percentage of output valued in producers' price) | Domestic sales (transportation charges from producers to purchasers [delivery transportation cost] as a percentage of output valued in delivered price) | Exports (transportation charges from producers to the Canadian border as a percentage of output valued in delivered price) |
|---|---|---|---|
| *Range of average transportation charges in industry groups (medium level of aggregation)* | | | |
| 1. Primary industries | 0.79-13.17 | 1.40-19.79 | 4.26-14.76 |
| 2. Manufacturing | 1.91-6.81 | 1.58-6.07 | 1.55-8.01 |
| *Range of average transportation charges in the low level of industry aggregation* | | | |
| 1. Primary industries | 0.68-13.17 | 0.50-46.82 | 2.33-30.39 |
| 2. Manufacturing | 1.30-11.15 | 0.85-19.97 | 0.76-23.19 |

SOURCE: Skoulas (1981), Table 2, p. 18

primary industries they range from less than 1 per cent to over 13 per cent and for manufacturing from approximately 2 per cent to almost 7 per cent - at the medium level of aggregation (26 goods-producing industry groups). For the low level of industry aggregation (137 goods-producing industries) the ranges of average transportation charges are somewhat wider. For primary industries they again range from less than 1 per cent to in excess of 13 per cent, while for manufacturing industries they range from 1.3 per cent to approximately 11 per cent.

The second column in Table 1 shows the more traditional transportation costs associated with the movement of goods from producers to consumers. These are calculated as a percentage of output valued in delivered price to the consumer. For primary industries at the medium level of aggregation they range from 1.4 per cent to approximately 20 per cent and for manufacturing from 1.6 to 6 per cent. At the low level of aggregation we again find the ranges larger, with primary industries ranging from 0.5 to 47 per cent and manufacturing ranging from 0.85 to 20 per cent.

The third column gives transportation charges for exports calculated from the producer to the Canadian border. Again the range for the low level of aggregation is larger than for the medium level of aggregation and is approximately the same as for domestic sales as reported in the second column.

The figures in Table 1 show the importance both of the direct and indirect transportation charges in the production cost and of the more traditional transportation costs associated with moving commodities to the final consumer. The results conform to our expectations, with larger ranges of prices for lower levels of aggregation and with higher transportation costs associated with primary industries than with manufacturing. Even in the manufacturing sector, however, we find transportation costs from producers to final consumers as high as 20 per cent.

Skoulas has pointed out that even these figures substantially underestimate the true transportation costs. Transportation costs from producers to final consumers include only those costs of for-hire transportation services and do not include privately owned transportation services. Thus the transportation cost for a firm that transports its own product would be included in the production costs and not in the transportation cost. In a separate part of the study Skoulas estimated that privately owned trucking accounts for some two-thirds of total truck transportation

and approximately one-half of the total transportation for the economy as a whole. Thus approximately one-half of the total transportation between producers and final consumers is not included in the second column of Table 1. This is not to say, of course, that these figures should be doubled, for it seems likely that more privately owned transportation is local in nature than long-distance.

Another source of bias is the various subsidies afforded certain commodities by the transportation policy of the federal government. Of particular importance are the Crow's Nest Pass Agreement and the Livestock Feed Assistance Act, both of which substantially reduce the cost of transporting grains for Western producers.

Also of importance is the fact that these are average transportation costs for the economy as a whole. Thus for a manufacturer in Ontario they include the cost of transporting the final product to nearby consumers as well as the cost of transporting the commodity to consumers in British Columbia and Newfoundland. Our primary concern in later chapters is with transportation between regions, and the figures in Table 1 will be a substantial underestimate of the costs this entails. This understatement is increased by the fact that a large proportion of the customers of the manufacturing sectors in Ontario and Quebec are quite close at hand, thereby substantially biasing the averages downward.

Table 2 presents a range of average transportation charges by commodity groups. These are total transportation costs and thus the figures in the first column correspond to the sum of those of the first two columns of a table of transport costs by commodity group similar to Table 1. We note that for the high level of aggregation the range is from 2.5 to 28 and for the low level of aggregation from approximately 2 to 53. For exports the averages are higher (not shown), and the range for the high level of aggregation is somewhat less while for the low level of aggregation it is somewhat wider. Again we note both the wide variation in transportation charges as a percentage of final consumer price and the significance that transportation costs play in determining final consumer price for many commodities.

The important role that transportation costs play in determining final consumer price is also illustrated in Table 3, which shows the distribution of commodities for various ranges of transportation costs as a percentage of producer prices. For domestic sales we note, for example,

TABLE 2
Range of average transportation charges in commodity groups, 1974

| | Domestic sales (total transport costs a) embodied in production and b) from producers to purchasers as a percentage of output valued in purchasers' price) | Exports (total transport costs a) embodied in production and b) from producers to the Canadian border as a percentage of output valued in purchasers' price) |
|---|---|---|
| Commodity groups (high level of aggregation) | 2.46-28.19 | 4.48-19.57 |
| Commodities (low level of aggregation) | 1.84-53.50 | 2.74-63.21 |

SOURCE: Skoulas (1981), Table 5, p. 24

that for almost 24 per cent of all commodities, transportation cost is more than 10 per cent of the total producer price. These commodities represent some 14 per cent of the total value of domestic sales of these industries. For exports, over 32 per cent of the industries have transportation costs that make up more than 10 per cent of the value of output, these representing more than 55 per cent of the total value of exports for these industries. Clearly for a significant number of commodities transportation charges are an important element of consumer price, and again it must be remembered that these estimates are substantially biased downwards by the neglect of private trucking and by the fact that they are averages for the economy and do not reflect the interregional transportation costs with which we are principally concerned.

## 3. CANADIAN REGIONAL POLICY

It has long been recognized that Canada is a distinctly regional economy and that the regions differ substantially both in terms of their endowments of factors of production and in such economic policy variables as factor prices, unemployment rates, and productivity. Consequently a good

TABLE 3

Distribution of commodities by total transport charges, 1974

| Total transport costs a) embodied in production b) from producers to purchasers as a percentage of output valued in producers' price | Domestic sales | | | |
|---|---|---|---|---|
| | Number of industries | Percentage share of total | Value of domestic sales ($000,000) | Percentage share of total |
| less than 5 per cent | 134 | 25.72 | 26,386.62 | 32.22 |
| 5-10 per cent | 264 | 50.67 | 44,132.10 | 53.88 |
| 10-15 per cent | 77 | 14.78 | 7,391.67 | 9.02 |
| over 15 per cent | 46 | 8.83 | 3,997.16 | 4.88 |
| Total | 521 | 100.00 | 81,907.55 | 100.00 |

| Total transport costs a) embodied in production b) from producers to purchasers as a percentage of output valued in producers' price | Exports | | | |
|---|---|---|---|---|
| | Number of industries | Percentage share of total | Value of exports ($000,000) | Percentage share of total |
| less than 5 per cent | 104 | 19.96 | 8,736.47 | 30.55 |
| 5-10 per cent | 246 | 47.21 | 4,306.28 | 15.06 |
| 10-15 per cent | 106 | 20.35 | 12,823.29 | 44.86 |
| over 15 per cent | 64 | 12.48 | 2,725.12 | 9.53 |
| Total | 521 | 100.00 | 28,591.16 | 100.00 |

SOURCE: Skoulas (1981), Table 6, p. 26

deal of attention has been paid to the regional nature of the economy and much has been written about these problems and about possible solutions. While much of the research has been descriptive and empirical some of the more recent analyses have developed quite sophisticated theoretical models.

Perhaps the best description of these regional differences is the study prepared by the Economic Council of Canada (1977). This study very carefully analyses the historical pattern of differences among regions in Canada but does not provide a theoretical framework on which these differences can be seen to depend.

One of the interregional issues that has received a good deal of attention is interregional migration of labour. Several studies have analysed the relationship among interregional labour mobility, wage-rate differentials, and the overall adjustment process. Basic references would include Courchene (1970) and Vanderkamp (1968).

Another area that has received considerable attention is the system of interregional transfers. Early significant contributions include Courchene (1978), and more recently Boadway and Flatters (1982) have analysed this issue using a simple general-equilibrium model of two regions. While their analysis is very suggestive it is very simplistic on the production side and assumes that labour is the only factor of production. Their principal concern is with the consequences of interregional transfers, and thus while the regions interact the economy as a whole is closed to the rest of the world. Trade issues and factor mobility are therefore not considered.

General-equilibrium models have also been employed to examine other issues. Chambers and Gordon (1966), for example, investigated the effects of the wheat boom on the Canadian economy. While their analysis is general-equilibrium it is essentially a two-sector model which is regionalized by assuming that one sector is in each of the two regions. Thus the interactions between regions are essentially the interactions between the two sectors, and one cannot analyse both intersectoral and interregional adjustments with this framework. Other papers that can be given a regional interpretation include Burgess (1976, 1980), but here again regions are identified with industries.

Several authors, including Courchene and Melvin (1980), Norrie and Percy (1981), and Thirsk (1973), have analysed the consequences for a regional economy of changes in the

terms of trade. The motivation for these studies was the rapid increase in the price of petroleum that occurred in the 1970s, and the question at issue was how a regional economy such as that of Canada could adjust to the shock. These papers are mainly descriptive and analyse the questions of how balance-of-payments problems between regions can be worked out in a situation where one cannot rely on adjustments in the exchange rate.

Recently several authors have developed general-equilibrium models of particular regions and have attempted to identify the important intersectoral linkages between various sectors. Among these are Copithorne (1981) and Norris and Percy (1981, 1983). These models hypothesize several production sectors, usually each with a specific resource, and trace through the effects of such things as resource price changes or, as in the Norrie-Percy (1983) paper, changes in the structure of transportation costs. Constant returns to scale are typically assumed, and while the model of the region is carefully specified the region is assumed to be a small open economy relative both to the rest of the economy and to the rest of the world. Thus there are no genuine interregional adjustments.

Hazledine (1980) has developed a non-neoclassical general-equilibrium model to analyse the regional consequence of the Canadian tariffs structure for the Quebec economy. His main departure from the traditional model is to assume that manufacturing firms have some market power because products are differentiated. Price is set as a margin over costs and account is taken of the likely reaction of present and potential competitors and of whether or not import substitutes exist. The Herfindahl Index of seller concentration is used to capture the strength of the threat of potential competition. This model is prone to the criticism of all such models, namely that they tend to be ad hoc and not based on well-defined theoretical structures.

A major empirical study that addresses regional consequences of the Canadian tariff is Pinchin (1979). He surveys Canadian tariff history and estimates two kinds of costs of tariff removal. He first calculates the cost associated with the loss in tariff revenue and argues that on balance Ontario and Quebec have, historically, received more than their share of these revenues, in the sense that their receipts from tariffs have been more than in proportion to the losses associated with higher commodity prices. Thus he argues that Ontario and Quebec would be net losers from

tariff removal. He also analyses the employment costs of tariff removal and again finds that the big losers will be Ontario and Quebec. His principal conclusion is that Ontario and Quebec, particularly Ontario, have been the benefactors of the Canadian tariff structure.

The Pinchin study can be criticized on a number of grounds. The calculation of employment costs associated with tariff removal simply assumes that new imports will be substituted for domestic production and takes no account of possible rationalization of the manufacturing sector. The model also presupposes that it is the manufacturing sector that has been the principal benefactor of the tariff. The task is then simply to calculate how much Ontario and Quebec have been benefactors and how much the West and the Maritime provinces have lost. No theoretical structure is provided, however, to justify his assertion that tariffs benefit the manufacturing regions.

Recent work by Harris (1984a, b), while not specifically regional, has important implications for the issues being considered here. Harris, using a model incorporating increasing returns to scale that are internal to the firms, finds that tariff elimination, either unilaterally or multilaterally, will have substantial benefits for the Canadian economy. These benefits are associated with the rationalization of the Canadian manufacturing sector, allowing firms to produce larger volumes and export to markets in the United States. While specific regional calculations are not undertaken it is clear that the principal benefactors of trade liberalization in the Harris model will be the industrialized provinces, namely Ontario and to a lesser extent Quebec. Conversely, while all provinces have suffered the consequences of higher prices associated with the tariff structure, Ontario has been particularly disadvantaged by the tariff because it has prevented industry from achieving efficient scale of operation. The Harris analysis presents strong evidence that Ontario will be a principal benefactor of any move towards free trade with the United States.

## 4. INTERNATIONAL TRADE

In this study we will consider a regional economy, assumed to be small, engaged in international trade. A principal focus of the analysis will be the consequences of differing regional trade patterns. Thus standard trade models are central to the analysis. It would be neither feasible nor

appropriate, however, to attempt a review of the broad and diverse international trade literature here. Rather the required tools and standard theorems will be developed as needed and relegated to appendixes.

While international trade models provide the analytical framework for the analysis of this study, few studies have analysed the implications of international trade within the context of a regional economy. Two papers that are related to this analysis are Bhagwati and Brecher (1980), and Brecher and Bhagwati (1981), which dichotomize the economy according to the ownership of factors of production. They assume that some factors are owned by domestics and others owned by foreigners and analyse the consequences of such things as tariffs and changes in the terms of trade. As will be seen in Chapter 3, some of our conclusions are closely related to theirs. A recent paper by this author (Melvin 1985a) has considered the consequences when there are two distinct consumer groups within a single economy. One of the applications of this model is to consider these two consumer groups as being residents of different regions, and some of the implications are similar to the conclusions of Chapter 3 of this study. This is particularly true of the influence of tariffs and of the consequences of interregional trade.

Before concluding it may be useful to make a few comments on the basic approach. The methodology has two basic characteristics: the analysis is theoretical and a general-equilibrium approach is employed. It is my firm belief that a clear theoretical understanding of any problem is a precondition to sensible policy analysis. Regional policy has, I believe, suffered substantially from the fact that we have not had a clear understanding of the causes of many of the interregional disparities observed in the Canadian economy. Of course, policy analysis also requires empirical work, but solid empirical analysis cannot proceed in a vacuum. It is hoped that this study will provide a starting-point for the theoretical analysis that will be required for a clear understanding of the regional problems that exist in Canada.

The analysis is general-equilibrium in nature because the central issues are general-equilibrium in scope. Policies designed to change the welfare of all inhabitants of a region or to address regional unemployment differences must take cognizance of the interactions that exist not only among sectors but also among different regions. Such analysis is only possible if a general-equilibrium framework is employed.

Finally it should be noted that our approach is taxonomic in terms of the theoretical models considered. Thus in Chapter 3 we assume constant returns to scale and attribute trade to differences in endowments of factors of production. Chapter 4 analyses the consequences of assuming that capital is immobile between sectors. In Chapter 5 we introduce increasing returns to scale but assume that factors of production exist in the same proportions in each of two regions. Such models are often criticized because of their unreality. It must be emphasized that the purpose of this analysis is to identify the consequences, for regions and for the economy, of determinants of trade such as increasing returns to scale and endowment differences. This can only be achieved if other factors that could give rise to trade are neutralized. The models set out in each chapter are not intended as a description of the real world but are deliberately stylized in order to capture the effect of a particular factor. Only in this way can one be confident about understanding the underlying determinants of the results the model produces. In the concluding chapter we analyse which of the results are robust in terms of the various models examined and which depend on the specific assumptions required for their derivation.

## 5. CONCLUSIONS

There is a substantial literature that bears directly and indirectly on the topic of this study, and the above summary has not been at all exhaustive. But while much of this research is closely related to the principal issues, none combines the various elements with which we are interested and analyses them in terms of a systematic, well-defined general-equilibrium model. The remaining chapters in this study will attempt to provide a basic framework using a simple general-equilibrium analysis that one can use to consider regional issues for an open economy.

# 3

# An endowment model of regional trade: the long run

As was noted in Chapter 1 there are a variety of explanations for the trade that takes place among regions and among nations. The policy implications of each may differ, so that a full understanding of policy options requires a complete understanding of the various models of trade determination and their implications. This chapter investigates the implications of trade arising from differences in factor endowments. The model employed is the Heckscher-Ohlin model from international trade theory.

In the search for an explanation of Canadian trade, either international or interregional, the Heckscher-Ohlin model is not the most appealing theoretical approach. It assumes that the only factors of production are capital and labour and that these are perfectly mobile among industries. It abstracts from natural resources, and assumes that all production takes place under conditions of constant returns to scale. In the Canadian context both returns to scale and natural resource endowments would have to be included in any comprehensive explanation of Canadian trade patterns, and such models will be introduced in subsequent chapters. The endowment model provides a useful starting-point for our discussion, however, for several reasons. First, it is the most popular explanation of international trade and its implications are well understood by economists. Second, it can be converted into either a short-run endowment model or a model in which resources play a prominent role by dropping the assumption that capital is mobile and replacing it with the assumption that some factors are sector-specific. Third, it provides a standard against which other models can be compared.

The model itself, while quite simple and well understood by international trade economists, is nevertheless theoretical

in nature, and an understanding of the propositions presented here will require some familiarity with this body of theory. Furthermore, while the propositions we will provide in this chapter are quite straightforward, many of them are new and will require some discussion even for those familiar with the basic models. In order to provide as simple a statement of the basic propositions as possible and at the same time provide some more detailed discussion of the principal propositions, the main body of the chapter will consist, by and large, of a non-technical description of the results, the more technical material being relegated to Appendix A, where the section headings correspond to those in this chapter.

## 1. THE MODEL

In this chapter we consider the Heckscher-Ohlin model from international trade theory. We assume two goods, X and Y, produced with capital, K, and labour, L, under conditions of constant returns to scale. The two factors are assumed to be in fixed supply for the economy as a whole. We assume that preferences can be represented by a set of community indifference curves, and we further assume that the preferences of individuals are identical regardless of their region of domicile. It is initially assumed that the economy as a whole is small relative to that of the rest of the world so that commodity prices can be assumed given. This implies that both regions are also small relative to the rest of the world.

Our model is differentiated from the traditional one by the assumption that factors of production, rather than being located at a single point, are located in two distinctly different regions, the East, E, and the West, W. A second crucial assumption is that transportation costs between these two regions are significant and are larger than are transportation costs between either of these regions and the rest of the world. This assumption seems realistic for many products produced and consumed in Canada. For example, transportation costs between Toronto and Vancouver will be larger than transportation costs between Toronto and Buffalo, or between Vancouver and Seattle. Of course such an assumption will not be appropriate for all goods produced in Canada, for much of our trade is with countries other than the United States, and for such countries international transportation costs may well be larger than interregional

costs. Furthermore even some markets in the United States are distant from the Canadian producers who supply them. Nevertheless this assumption does seem appropriate for a large class of trade, and while not appropriate for all commodities will at least describe an important limiting case.

A further simplification will be to assume that it is the difference between the international and interregional transportation costs that is the important variable. From a theoretical point of view this is equivalent to assuming that while positive transportation costs exist between E and W, the transportation costs between E and W and the rest of the world are zero.

To further simplify the analysis it will be assumed that both regions in Canada face the same set of world prices. One can imagine a large integrated outside world with so much interaction that commodity prices have been equalized so that the prices faced by consumers in the Eastern United States are the same as those faced by residents in the West. This assumption significantly simplifies the analysis, for it implies that in a free-trade situation the two regions face the same set of commodity prices, which has important implications for factor rewards. The assumption is not crucial to the principal conclusions of the analysis, however, and can be relaxed.

A final important assumption is that the capital and labour endowments of the two regions differ. In particular we assume that region E is relatively well endowed with capital while region W is relatively well endowed with labour.[1] It is further assumed that commodity Y uses a higher proportion of capital at any equilibrium factor-price ratio than does commodity X, or in other words that commodity Y is capital-intensive and commodity X labour-intensive. Together these two assumptions imply that region E has a comparative advantage in the production of commodity Y while region W has a comparative advantage in the production of X. This is a well-known result from international trade theory and follows immediately from the assumptions.

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1 For simplicity it is assumed that an individual is either a labourer or a capitalist, but never both. This simplifies the subsequent analysis of factor flows. Recall that all consumers, whether labourers or capitalists, have identical utility functions.

Region E, being relatively well endowed with capital, is relatively efficient in the production of the capital-intensive good Y, while region W has an advantage in the production of X, the commodity that uses its abundant factor most intensively. These results, along with the assumption of constant returns to scale, allow the construction of the production possibility curves for regions E and W shown in Figure 3.1. Here $T_E A_E T'_E$ is the production possibility curve for region E and $T_W A_W T'_W$ is the production possibility curve for region W.[2]

Because of the assumption that both regions are small and face the same world-price vector we can now impose the price line P for the two regions in Figure 3.1. The assumption of perfect competition in both factor and commodity markets results in equilibrium production at $A_E$ and $A_W$ in regions E and W respectively. Consumption will be at points $C_E$ and $C_W$ where the common set of indifference curves for the two regions are tangent to these price lines. Note that $C_W$ and $C_E$ both lie on the same straight line from the origin. This is a consequence of the assumption that tastes are identical and homogeneous in the two regions. A more detailed construction of the production possibility curves for the regions is provided in Appendix A, Section 1.

The situation shown in Figure 3.1 is the most interesting configuration of consumption and production for our regional model, and will be the one considered through most of this chapter. Other possible configurations exist, however. Implicit in Figure 3.1 is the assumption that at world prices P both regions produce both goods. This is by no means necessary, for one or both regions could, with free trade, be specialized and produce only one good. Whether or not specialization will occur will depend on world prices, on the underlying production functions for the two commodities, and on the relative factor endowments of the two regions. Furthermore, specialization in one region cannot be an equilibrium if we assume interregional factor mobility (see Appendix A, Section 6).

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2 It is assumed that capital and labour remain in their home region unless factor payments are higher elsewhere. In the initial situation shown in Figure 3.1 factor prices are equalized in the economy, so there is no tendency for factors to move.

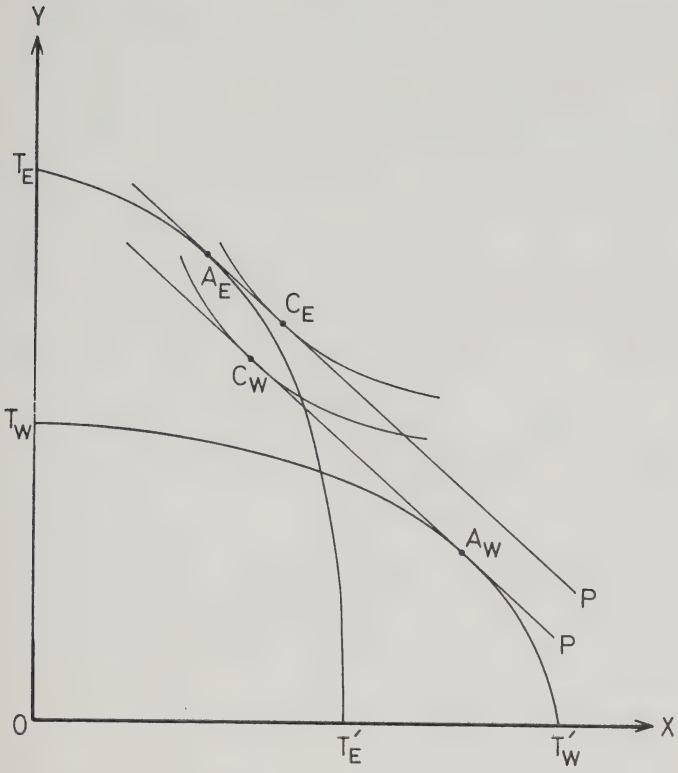


Figure 3.1

An interesting consequence of Figure 3.1 is the fact that in equilibrium the trade patterns for the two regions differ. Recalling the assumption that transportation costs between regions are positive and transportation costs internationally are zero it is clear that both regions will be trading, not with each other, but with the rest of the world. Region E is producing at $A_E$ and consuming at $C_E$ so that its trade vector is $A_EC_E$. Thus region E is exporting Y and importing X. Region W has a trade vector $C_WA_W$ and is therefore exporting X and importing Y. For the economy as a whole we note that X and Y are both imported and exported, so that we have cross-hauling of both commodities. The phenomenon of cross-hauling has sometimes been thought to be at variance with simple international trade models, but it is clear from Figure 3.1 that cross-hauling is to be expected in the regional economy

we are considering here.[3] We thus have the following proposition.

*Proposition 3.1* If interregional transportation costs are higher than international transportation costs, and if regional trade patterns differ, then cross-hauling of identical commodities would be expected for the economy as a whole.

Such cross-hauling is not a necessary consequence of this regional model, however. Imagine a situation where consumption is so biased towards commodity Y that consumption for both regions lies to the left of the line through O and $A_E$ (not shown). In this case both regions would export Y and import X. The assumption made in Figure 3.1, that regions import and export different commodities, seems reasonable when one considers the Canadian economy, and thus this case will be considered throughout.

Another issue that can be dealt with in terms of Figure 3.1 is the effect of a terms-of-trade change. The terms of trade refers to the ratio of commodity prices faced by the economy (price line $P = P_x/P_y$ in Figure 3.1), and an improvement in the terms of trade refers to a situation where the relative price of the export good increases, allowing the purchase of a larger quantity of imports, thus moving the economy to a higher community-indifference curve. The analysis of a terms-of-trade change is complicated in this model by the fact that both goods are imported. How then do we define an improvement in the terms of trade? Referring again to Figure 3.1 we note that the trade vector for the economy as a whole is $A_EC_E + C_WA_W$, or simply the sum of the trade vectors for the two regions. One could define net trade for this economy as the difference between these two trade vectors, and in the figure shown, since $C_WA_W$ is greater than $A_EC_E$, the economy as a whole is a net importer of commodity Y and a net exporter of commodity X. One could therefore define an improvement in the terms of trade for the economy as a relative increase in the price of commodity X.

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3 Cross-hauling will also occur if regional tastes differ. See Melvin (1985a). The more usual explanations of cross-hauling are inter-industry trade or trade in differentiated products.

It is clear, however, that an increase in the price of X will have a different welfare effect on the two regions. Because region W exports commodity X an increase in the relative price of X will increase utility, while in region E where X is the import good we have the opposite result. Because E imports X an increase in the price of that commodity will make region E worse off. Thus we have the following proposition.

*Proposition 3.2* If regional trade patterns differ, an improvement in the terms of trade for the economy as a whole will increase welfare in some regions and reduce it in others.

This result is of interest for it shows that any external change that affects world prices can have different effects on different regions in the economy. Some regions will be made better off and others worse off, and the question naturally arises as to whether the losing regions should be compensated in some way. The possible consequences of such compensation are complicated by the fact that, since commodity prices are still equalized across regions, factor prices between regions are also equalized. This question will be considered further in Section 6 of this chapter.

## 2. THE EFFECTS OF TARIFFS

The consequences of tariffs in this regional trade model differ in several respects from traditional trade theory results. First, as we have already noted, both goods are exported and imported by the economy so that tariffs can be applied to either or both goods. It is easily shown that the effects of a tariff on Y are symmetrical to those of a tariff on X so that only the effects of one tariff need be examined in detail. In Figure 3.1 the economy as a whole was shown to be a net importer of commodity Y, and it therefore seems appropriate to consider the consequences of the imposition of a tariff on Y.

First, recall that a tariff is just a special kind of tax that is applied to a commodity when it enters the country from abroad. A tariff can only be effective if it is applied to a commodity that is imported. Because of our transportation cost assumption the two regions are both importing from the rest of the world and are not trading with each other. It is therefore clear that, at least initially, a tariff on

commodity Y can only affect region W, for region E does not import any Y. In region W a tariff has the usual effect of increasing the price of the taxed commodity both to consumers and for producers. The diagrammatic analysis of the tariff is provided in Appendix A, Section 2. The welfare loss associated with the tariff is due to the fact that the tariff introduces a distortion between domestic prices faced by consumers and producers and prices that prevail in the rest of the world. This is the traditional result. The difference for our regional model is that the tariff only affects region W and produces no price distortions in region E. Thus we have the following proposition.

*Proposition 3.3* The distortionary effects of a tariff only affect regions that are importers of the commodity on which the tariff has been imposed.

This is an important result for it shows that tariffs have distinctly different regional effects even for the small open economy being considered here. Also, as mentioned earlier, a tariff on commodity X would have a similar effect except that in this case only region E would be affected. A uniform tariff structure that increases the price of both commodities would produce both effects and would make consumers in both E and W worse off. Note that in no sense would uniform tariffs on both commodities be offsetting. A uniform tariff on commodities X and Y would change equilibrium production and consumption in the opposite directions in the two regions, and the effects would be independent.

Implicit in any discussion of the welfare consequences of tariffs is the assumption that the tariff revenue is redistributed to the consumers from whom it was collected. In traditional trade analysis it is generally assumed that this distribution is made in lump-sum fashion so as to avoid any further distortionary effects. But while this assumption is quite appropriate in a model in which all consumers are at the same location it is not appropriate for our regional model. For the case of a tariff on commodity Y this assumption implies that whatever tariff revenue is collected is entirely returned to residents of region W, the individuals who were required to pay the tariff. This is not how we would expect tariff revenue to be redistributed in a federal state, however. A more appropriate assumption, given the fact that tariffs are collected by the federal government,

is that all citizens of the economy benefit from the redistribution of the tariff revenue. This implies that while the tariff is collected only from consumers in one region it is redistributed to all consumers in the economy, and thus while the welfare losses associated with the distortionary price effects of a tariff are borne only by consumers in one region, the gains associated with the redistribution of tariff revenue are shared by everyone. We therefore have the following proposition.

*Proposition 3.4* If the tariff collected on a commodity is returned to all domestic consumers, residents in the region importing that good suffer an additional loss and residents of the region exporting the commodity enjoy a welfare gain.

This result is of interest because it illustrates the fact that tariffs can not only produce welfare losses but can result in a redistribution of national income among residents of the economy. Note that the residents of the region that is affected by the tariff bear a double burden: they suffer the welfare loss associated with distortionary prices and they do not receive all the tariff revenue collected on the goods they import. Proposition 3.4 also suggests the possibility that tariffs might become a policy tool for the redistribution of income. If one of the regions is relatively larger than the other and has more political power it would be in the interest of that region to persuade the federal government to impose a tariff on the imports of the smaller region. Such a tariff would result in a transfer of income from the smaller to the larger region.

There are several other implications of tariff imposition in this model. Because a tariff results in different relative commodity prices in the two regions it also results in different relative factor prices and, as will be seen in Section 6, this may result in interregional factor flows. The consequences for the welfare of capitalists and labourers will also be taken up later in this chapter.

There is another consequence of the fact that a tariff, or a system of tariffs, will result in different commodity prices in the two regions. Because commodity prices differ, producers in the two regions will be using factors in different proportions, and from the point of view of the economy as a whole inefficient production will be the

result. Compared to an economy without this regional structure the production point associated with any tariff structure will lie strictly inside the economy's overall production possibility curve. Therefore we have the following proposition.

*Proposition 3.5* Any tariff produces a dead-weight production loss for an economy where regional trade patterns differ.

## 3. TARIFFS AND INTERREGIONAL TRADE

Our analysis assumes that interregional transportation costs dominate international transportation costs, and in fact we have simplified the analysis by assuming that international transportation costs are zero. This assumption has resulted in a situation where both regions trade with the rest of the world rather than with each other, and has essentially isolated the two regions. It is this isolation that has given rise to the results that tariffs affect regions differently.

But even if interregional transportation costs are high they are certainly not infinite, and if tariffs continue to be increased on the imports of one or both regions a point will be reached where the tariff rate becomes as high as the transportation cost. When this occurs consumers in the region affected by the tariff will be indifferent between buying the commodity from the foreign country and paying the tariff, and buying the commodity from the other region and paying the transportation cost. Any further increase in the tariff would tip the balance in favour of interregional trade. Note that with such interregional trade the entire cost of transportation must be borne by the region affected by the tariff. The other region can never be forced to pay any of the transportation cost for it always has the option of exporting to the rest of the world. The importing region must therefore pay either the tariff or the transportation cost and it can pass neither of these on to the other region.

This switch from international to interregional trade has a significant welfare cost that does not seem to have been fully appreciated in the international trade literature. At the point where the tariff becomes as high as the transportation cost, thereby inducing consumers to buy interregionally rather than internationally, two changes occur. First,

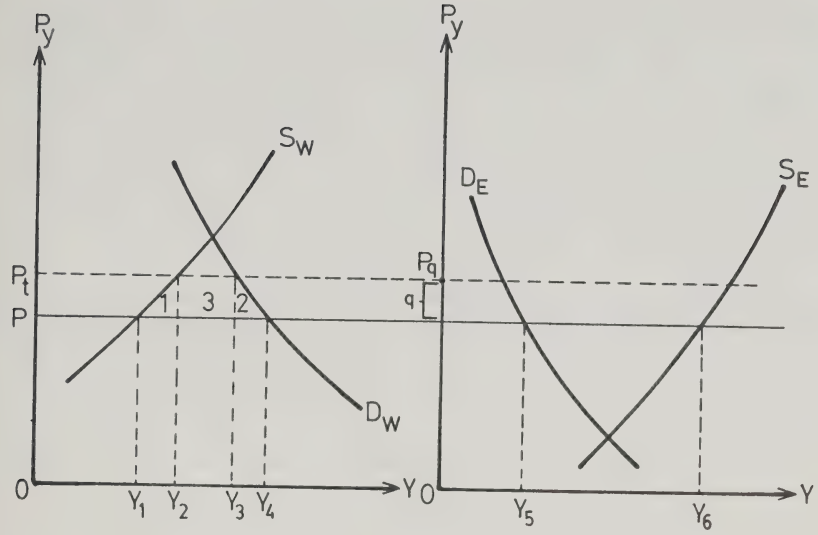


Figure 3.2

because the region is no longer importing the commodity from abroad, no tariff is collected and thus the entire tariff revenue is lost. Second, because of the distance between the two regions, real resources must be used up to transport commodities from one region to another. Note that this use of resources does not provide any commodities that directly enter the utility function of the consumers. Thus interregional trade, when compared to international trade, results in a use of resources that is unnecessary and that reduces the production of consumer goods that otherwise would have been available for residents of the importing region.

The general-equilibrium analysis of this welfare loss is given in Appendix A, Section 3. Figure 3.2 provides a simple partial-equilibrium analysis for the case of a single traded commodity. The left-hand panel represents region W and the right-hand panel region E, and in the initial situation world prices for commodity Y are given by P. These world prices result in imports of $Y_1Y_4$ for region W and exports of $Y_5Y_6$ for region E. It is assumed that the transportation cost between the two regions is q, and thus W will not import from region E unless the price of Y exceeds $P_q$.

Now suppose the federal government imposes a tariff at rate t on commodity Y. Such a tariff will not affect region E since no Y is being imported, but will raise the price in region W to $P_t$. This tariff has the usual welfare consequences familiar from cost-benefit analysis and will result in a dead-weight loss of areas 1+2. Note that area 3 is the tariff revenue collected by the government. This is assumed to be returned to consumers in lump-sum fashion so that prices are not affected.

Now suppose that tariff rate t is just equal to the transportation cost q. Any higher tariff will result in region W importing commodity Y from E and paying price $P_q$. This switch to interregional trade means that the tariff revenue formerly collected is lost, and thus area 3 in Figure 3.2 now becomes part of the dead-weight loss associated with the tariff. The dead-weight loss for region W is now areas 1+2+3, as compared to 1+2 for international trade.

Thus we have the following proposition.

*Proposition 3.6* If the tariff generates interregional trade there is a sudden discrete fall in domestic consumption and welfare equal to the loss of tariff revenue.

It may, on first sight, seem odd that a very small change in a tariff could result in a substantial fall in the consumption, and therefore welfare, of consumers in region W. Why would consumers undertake to engage in interregional trade if such trade results in a significant welfare loss? The answer is easily found. Consumers are maximizing their utilities subject to the prices they face. This maximization behaviour quite correctly leads them to buy commodity Y from region E when they see the price there lower than it is in the rest of the world. They do not take account of the tariff revenue because they do not receive this in the initial transaction. Some part of the tariff revenue will be returned to them in lump-sum fashion, but they do not take account of this in their decision as to whether to buy commodity Y internationally or interregionally.

Also note that the loss in tariff revenue must be exactly equal to the cost of transporting commodity Y from region E. The transportation cost per unit can be thought of as a kind of tariff, the difference being that while a tariff is collected a transportation cost is dissipated. Tariffs and transportation costs would have exactly the same effects if

the government, after collecting the tariff, gave it away to foreigners or destroyed it.[4]

Proposition 3.6 would seem to have significant implications for policy analysis in the Canadian economy. Canadian tariff policy dating back to the National Policy has been specifically designed to encourage interregional trade at the expense of international trade. To the extent that it has been successful a substantial cost has been borne by consumers in Canada, which is, of course, not to say that such a tariff policy has been completely without merit. It is often argued that the National Policy was required to keep Canada a single nation, and the analysis presented here abstracts completely from such political considerations. Our results are not intended to suggest that the National Policy and subsequent tariff regimes have been mistakes from a political point of view. Our analysis simply argues that some components of the costs of this policy may not have been completely understood.

There is a further point concerning the losses associated with the generation of interregional trade. Figure 3.2 shows that interregional trade will result in a loss of tariff revenue equal to area 3, and implicit in the argument is the assumption that this tariff revenue had been distributed entirely to consumers in region W. As noted in Proposition 3.4, however, tariff revenues are generally distributed to all residents in an economy, and not just to those residents in the region that imported the commodity on which the tariff was levied. In these circumstances the switch from international to interregional trade will result in a loss of welfare to all consumers in the economy. More generally the losers will be those consumers in the economy who previously received the benefit from the tariff revenue.

The analysis here has examined the case of a tariff on commodity Y. A tariff on commodity X can be handled in an exactly analogous way. The tariff will initially result in price distortions for the region importing X, and if the tariff becomes high enough will result in interregional trade. This interregional trade will have exactly the same

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4 Note that the consequences of forcing interregional trade through tariffs are the same as for voluntary export restraints, where the government allows foreigners to obtain the quota revenue.

welfare costs as analysed in Figure 3.2. There is, of course, no reason to believe that the transportation costs for these two commodities will be exactly the same. Thus a common tariff structure might result in interregional trade in one commodity but not the other. As we shall see subsequently, this may have important consequences for the pattern of trade for the economy as a whole.

There are several other implications of tariffs for this regional economy. In Figure 3.1 the demand and supply conditions assumed resulted in net imports of commodity Y for the economy as a whole, because of the fact that the trade vector for W, the importer of Y, was larger than the trade vector for E. As is shown in Appendix A, a tariff imposed on commodity Y will necessarily reduce imports of Y by region W. If a large enough tariff is imposed the trade vector for W may be sufficiently reduced to become smaller than the trade vector for E. In this circumstance the economy would switch to being a net exporter of commodity Y, and thus a tariff can change the economy's patterns of trade.

If the tariff results in a switch to interregional trade even more interesting trade patterns can develop. As a special case suppose that the tariff in region W on commodity Y resulted in interregional trade, and that the quantity of imports required by W is just equal to the amount that region E had been exporting to the rest of the world. We would now have the following trade pattern. Region W exports commodity X to the rest of the world and imports Y from region E. Region E exports commodity Y to W and imports commodity X from the rest of the world. Examining the trade patterns for the economy as a whole, we note that the economy is exporting commodity X (from region W) and importing X (to region E) and has no international trade whatsoever in commodity Y. Trade in Y has been internalized and therefore does not show up in international trade statistics.

A situation where there is international trade only in commodity Y could also be generated. This could result if a tariff were initially imposed on X and if, with interregional trade, the imports of region E were just exactly equal to what region W wanted to export. Of course, neither of these special cases is to be expected, for both depend on a perfect coincidence of excess demands and supplies between the two regions, and with arbitrarily chosen world prices there is no reason to expect any such equality. The point is that in this regional model with a tariff on one or the other of the

two goods, there can in general be no prediction as to what the pattern of trade will be.

This has interesting implications for the Heckscher-Ohlin model of international trade. That theory suggests that a country's trade pattern can be predicted by knowledge of endowments as long as demand patterns among countries do not differ significantly. In the traditional model tariffs can reduce the volume of trade but cannot change the pattern of trade. Quite different results have been found here, and thus we have the following proposition.

*Proposition 3.7* In a regional economy tariffs can reverse the pattern of net trade and thus the Heckscher-Ohlin theorem cannot provide a prediction of trade flows in the presence of tariffs. If tariffs generate interregional trade, one can have, as a special case, exports and imports of one commodity and no trade in the other.

## 4. TARIFFS AND TERMS-OF-TRADE EFFECTS

It has been shown that sufficiently high tariffs can generate interregional trade and that this will produce a welfare loss. In the example previously considered it was assumed that the region importing the tariff-ridden good was able to obtain enough of the commodity from the other region to satisfy its entire demand for that commodity. Specifically it was assumed that, with a tariff on Y affecting region W, the excess supply of commodity Y in region E was sufficient to satisfy region W's demand for Y. In general, however, there is no reason to expect such a result. If region E cannot provide all of the required Y then prices in region E will be affected and there will be further welfare consequences.

The simplest case is to suppose that in the initial situation world prices are such that region E neither imports nor exports either commodity. Now a tariff on commodity Y will first increase the price of Y to both consumers and producers in region W and, when the tariff exceeds transportation costs, will result in interregional trade of Y from region E to region W. But since region E is not trading at prevailing world prices, E can be persuaded to supply commodity Y only if the price of Y is bid up. This, of course, is an improvement in the terms of trade for region E and thus results in a higher level of utility. We therefore find that a tariff applied to the import commodity of region W

may, through an improvement in the terms of trade, result in a welfare gain for region E. Note that this welfare gain is above and beyond the gain associated with the receipt of tariff revenue referred to in Proposition 3.4.

This terms-of-trade effect on region E does not depend on there being no trade at the prevailing world prices. Suppose E initially exports a small quantity of Y to the rest of the world but that this is not sufficient to satisfy the demands by W when interregional trade is generated. Further interregional trade will require the bidding up of the price of commodity Y in region E just as before, and again region E will benefit.

Nor is it necessary that the two regions traded in opposite directions before the tariff was imposed. Consider the case where, at world prices P, both regions imported Y but the imports of region E were small relative to those of region W. A tariff on Y would first affect both regions in the same way, namely reducing imports of Y, but would soon completely eliminate trade for region E. Thereafter the argument would proceed as above. Higher and higher tariffs would reduce the welfare of region W and at some point would overcome the transportation barrier resulting in imports from E and a consequent improvement in the terms of trade. The terms-of-trade change in E could actually more than compensate for the initial loss of welfare associated with the tariff on its initial imports of commodity Y. We thus have the following proposition.

*Proposition 3.8* A tariff, by generating interregional trade, may improve the terms of trade for a region and increase welfare. The pattern of trade for the region may also be reversed.

## 5. TAXES AND TRADE

A well-known proposition in international trade theory is that any system of tariffs can be duplicated by a set of domestic taxes and/or subsidies. As is illustrated in Appendix A, Section 5, a 10 per cent tariff on commodity X is precisely equivalent to a 10 per cent production tax on commodity Y combined with a 10 per cent consumption tax on commodity X. In terms of this model one could not distinguish between the tax regime and the tariff, for they have exactly the same effect on both producers and consumers.

This equivalence between tariffs and a structure of domestic taxes is not maintained in the regional model we have developed here. The reason for this is easily understood when one reflects on how taxes and tariffs affect consumers in different regions. If the federal government imposes a tax on the production of Y then all producers of Y in the economy will be affected whether the region is an importer or an exporter of that commodity. Similarly, if the government imposes a tax on the consumption of X all consumers in the economy must pay the tax. A tariff, however, only affects consumers and producers in the region that imports the commodity on which the tariff has been imposed.

Consider another example. Suppose the federal government imposes a 10 per cent tariff on all commodities. In our model this will increase the price of X to both producers and consumers in region E and will increase the price of Y to both producers and consumers in region W. Prices to producers and consumers within a region will be the same but prices between regions will be significantly different. Clearly there is no set of commodity taxes that could be applied at the national level that would produce these results.

Further welfare consequences of commodity taxes are considered in Appendix A, Section 5. In particular it is shown that while tariffs cannot reduce community welfare below the autarky level, a national tax system, because it acts as a subsidy in one of the regions, could result in one region producing inside its production possibility curve. Thus domestic taxes are potentially more harmful than tariffs. We therefore have the following proposition.

*Proposition 3.9* If trade patterns differ between regions, a tariff system cannot be duplicated by a set of domestic taxes or subsidies. Furthermore taxes may reduce regional welfare below the autarky level.

Appendix A, Section 5 also shows that taxes and tariffs can have quite different effects on the volume of trade. This result is due to the fact that a system of taxes that acts like a tariff in one region will be equivalent to an export subsidy in the other. This is a consequence of the assumption that the good that is an import in one region is an export of the other, and any tax must treat both regions identically in terms of the effects on production. Thus a

tax system that reduces the volume of trade in one region will increase it for the other and there can be no general presumption as to how such a tax structure will affect trade for the economy as a whole. The change in the composition of trade is easily predicted, of course, for a production tax on Y and a consumption tax on X will increase exports (and reduce imports) of commodity X and will reduce exports (and increase imports) of commodity Y. As is shown in Appendix A, Section 5, the combination of these could be sufficient to reverse the economy-wide pattern of trade. This result is interesting for it shows that even without tariffs the trade pattern of an economy cannot be predicted from knowledge of endowments if domestic distortions such as commodity taxes exist. We therefore have the following proposition.

*Proposition 3.10* For a regional economy domestic taxes will have different effects on the volume of trade than will tariffs. Furthermore taxes may reverse the pattern of trade, and thus predictions of trade patterns cannot be made from knowledge of endowment differences if distortions such as taxes are present.

## 6. REGIONAL ECONOMIC POLICY

In previous sections our principal concern has been with the ways in which the regional structure of an economy affects the propositions derived from traditional trade theory. These results are of interest because of the light they shed on policy issues. Implicit in the traditional international trade analysis is the assumption of a single government in charge of all policy matters. However, countries characterized by distinct regions, of which Canada is an obvious example, typically have different levels of governments, each of which is responsible for a range of policy issues. Of course, regions and provinces do not correspond exactly but one can associate provinces (or at least groups of provinces) with regions without deviating substantially from the reality of the Canadian economy. Certainly the endowments and productive activities in Ontario differ substantially from those of the Prairie provinces, British Columbia, or the Atlantic provinces. Furthermore the distances between the centres of economic activity of these regions suggest that an analysis along the lines of previous sections could well provide interesting economic policy conclusions.

Several issues will be considered. It was shown that external effects such as changes in the terms of trade, or domestic policies such as tariffs, may have substantially different effects on different regions. The federal government has a long history of concern with interregional differences in per capita incomes and factor returns, and has pursued a wide range of policies that have attempted to ensure some degree of equality among the regions or provinces of the economy. We find an elaborate system of equalization payments, a variety of conditional and unconditional grants, and government departments such as DREE and DREI that have been specifically designed to assist specific industries in disadvantaged regions. The task of this section will be to consider the circumstances under which such interregional transfers should take place, and the form that such assistance should take. Subsequent sections will consider the consequences of interregional factor mobility generated by domestic policy actions, and the interactions between policies pursued by the federal and provincial levels of government.

Proposition 3.2 showed that any change in the terms of trade will result in welfare gains for one region and welfare losses for another for the case where regions export different commodities. These welfare gains will be in the form of higher per capita income for the gaining region, and such a change could prompt the federal government to pursue actions to bring the per capita incomes of the two regions closer together. Many of the interregional transfers carried out by the federal government can be seen as policies to correct just such differentials.[5]

The interesting point, however, is that while such a change in the terms of trade results in different per capita incomes for different regions, factors of production are still receiving the same return regardless of whether they live in region E or region W. This is a consequence of the factor-price equalization theorem (see Appendix A, Section 6), which shows that, given the assumptions of our model,

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5 The argument here assumes that capital owners reside in the region where their capital is employed. If capital is widely held the analysis becomes much more difficult, for then changes in the returns to factors employed in a region need not correspond to income changes for that region.

relative and real factor prices are a function only of relative commodity prices. The change in the terms of trade has resulted in a different set of commodity prices for the economy, but we still have the same commodity prices facing both regions. Factor prices will differ from what they were before the terms-of-trade change but they will not differ across regions.

Now consider the consequences of an interregional transfer to correct the differential in per capita incomes. Specifically, suppose there has been an exogeneous increase in the relative price of commodity Y leading to an increase in per capita income for residents of E and a fall in per capita income for consumers in W. Suppose a tax is levied on all residents of E and a transfer made to all residents of W. Given our earlier conclusion that all factor owners are receiving the same factor payments regardless of region of residence such a transfer will make all residents of region W better off than their counterparts in region E. By this we mean that all labourers in W will be better off than all labourers in E and that all capital owners in W will be better off than capital owners in E. And note that this is not a consequence of the size of the transfer or of the rate of tax in region E. Any small transfer will have exactly the same effect. Thus we have the following proposition.

*Proposition 3.11* Any small transfer from a gaining to a losing region to compensate for terms-of-trade changes will leave all factor owners in the losing region with higher factor incomes than their counterparts in the gaining region.

This result seems somewhat paradoxical for it suggests that a region may be made significantly better off even though no factor owners in that region are better off than factor owners elsewhere. The paradox is resolved by reference to the Stolper-Samuelson theorem and by noting that factors exist in different proportions in the two regions. The Stolper-Samuelson theorem (see Appendix A, Section 6) shows that any change in the terms of trade will have differential effects on factor owners. Given the assumptions of our model, an increase in the relative price of Y will increase the real and relative factor rewards for capital and will reduce the real and relative factor rewards for labour. Thus an increase in the price of Y will make capital owners

unambiguously better off and labour owners unambiguously worse off, and this will be true in both region E and region W.

Now recall that region E has a higher proportion of capital owners than does region W. Region E therefore has more of the individuals whose incomes have increased relative to region W and thus, on average, per capita income in E must have risen. This result is, however, entirely a consequence of the difference in the distribution of factor owners between the regions.

Proposition 3.11 calls into question the need for interregional transfers to correct differences in per capita incomes, at least in the case described here. The inequity in this case, if there is one, is that factor owners are being treated differently and not that in any real sense regions have gained or lost. If there is to be a redistribution of income then it should be to all losers, that is to all labourers regardless of location, and should be financed by a tax on all capital owners in the economy.

But such a policy would simply raise an additional question. Why is the new distribution of income associated with these new terms of trade any worse than the old one? Any change in the terms of trade will improve the welfare of some factors and reduce the welfare of others, but there is no well-defined criterion for deciding which distribution of income is the appropriate one. Of course, the federal government has the power to decide on how income should be redistributed among various consumers or factor owners, but one would presume that this decision would be made on a basis other than location.

An interesting corollary to Proposition 3.11 is the observation that the interregional difference in per capita income generated by the terms-of-trade change will not generate factor mobility among regions. This is because factor prices remain the same across regions as long as commodity prices are equalized. But now suppose a transfer of the kind referred to above is made in an attempt to compensate individuals in the losing region. By Proposition 3.11 we find that all factor owners in region W are better off than their counterparts in region E, which may well generate factor mobility. The factor mobility, of course, will be from region E to region W, or in other words individuals will be moving from the advantaged to the disadvantaged region. We thus have the following proposition.

*Proposition 3.12* Interregional transfers aimed at correcting per capita income differences associated with terms-of-trade changes will result in a flow of both capital and labour from the advantaged to the disadvantaged region.

Several caveats to the above arguments are required. First, the conclusions of these two propositions depend crucially on the assumptions of our model, and in particular on the assumption that both regions face the same set of commodity prices. If commodity prices differ, then by the Stolper-Samuelson theorem factor prices will differ, and the simple results outlined above will require modification. It will still be true, however, that changes in the terms of trade will result in per capita income changes as described, and the same relative factor-price changes will occur. Thus even if factor prices are not identical among regions transfers will have the same relative effects on the incomes of factor owners and could still result in factor mobility.

Second, the analysis implicitly assumes that individuals move from region to region strictly on the basis of factor payments. This is clearly an oversimplification, for location itself may well be an importamt determinant of whether people are willing to move. And, of course, many factors other than changes in the terms of trade will affect factor prices and regional per capita incomes, so that the analysis here is by no means complete.

In Section 2 above, we showed that tariffs will have differential effects across regions because a tariff on a commodity will only affect consumers in the region that is importing that commodity. A tariff results in a change in the prices facing both producers and consumers in a region, and therefore has much the same kind of consequences as a terms-of-trade change. The difference, however, is that a tariff only affects the consumers in one of the two regions.

Consider a tariff on commodity Y. Since region W imports Y the relative price of Y in region W will rise for both producers and consumers. From the Stolper-Samuelson theorem, and remembering that Y is the capital-intensive commodity, this price change implies that the real return to capital will rise and the real return to labour will fall. Thus the real wage rate will be higher in region E and real return to capital will be higher in region W. The tariff on Y has clearly resulted in interregional differences in real factor rewards.

Now consider a tariff on X. The relative price of commodity X will rise in region E, the region importing that commodity, but there will be no price changes in region W. Again from the Stolper-Samuelson theorem a relative price rise for X will increase the real return to labour, the factor used intensively in the production of X, and will reduce the real return to capital. Comparing the two regions, we note that the real return to labour will be higher in region E and the real return to capital higher in region W.

It is noteworthy that tariffs on either commodity result in exactly the same relative factor-price differentials between the two regions. And, of course, tariffs on both commodities would simply accentuate these regional factor-price differences. Whatever the tariff structure for the economy the real return to capital in region E, the capital-abundant region, will fall, and the real wage rate in region W, the labour-abundant region, will fall. Thus any tariff will have the effect of reducing the return to the factor that, in some sense, is most important in the production process of that region. We thus have the following proposition.

*Proposition 3.13* If regions have different trade patterns any tariff will generate interregional differences in real factor rewards. The abundant factor in each region will lose relatively and absolutely.

Proposition 3.13 suggests one possible reason for the differences in factor prices that have often been observed among Canadian regions. There has been much discussion about the reasons for such differences and a variety of government policies have been aimed at reducing the differentials. The analysis here suggests that federal government policy itself, namely the Canadian tariff structure, may well be an important contributory cause of these regional differences in factor returns. And note that the predictions of our model are broadly in accord with the facts of the Canadian economy. The Atlantic provinces, for example, would certainly be regarded as labour-abundant relative to Ontario and these provinces have relatively low real wages. Similar comparisons can be made between Ontario and Quebec. Comparisons between Ontario and British Columbia are more difficult, for it is not obvious whether British Columbia is relatively capital or labour abundant. Given the predominance of the forestry industry, which is highly capital-intensive, it may

well be that British Columbia is relatively well endowed with capital and therefore would be expected, in the face of tariffs, to have relatively higher wages.[6]

The model also has implications for policies designed to correct interregional factor-price differentials. Note that transfers among regions, while changing per capita incomes, cannot change relative factor rewards. Factor prices depend on commodity prices and these are a function of world prices and the tariff rates. Thus as long as tariffs persist factor-price differences will persist, and transfers aimed at redressing such differences will simply address the symptoms of the problem and not the cause. More important, transfers will be required year after year as long as the tariff structure is in place. The elimination of tariffs would remove the differentials once and for all.

There are also other costs associated with such transfers that are not taken into account in our simple model. It is often argued that the costs of collecting and redistributing taxes are high relative to the amount that actually reaches the final recipients. These costs of collection and dispersal are socially wasteful in that they do not directly result in goods or services that directly enter individuals' utility functions. There is, finally, the problem associated with any form of aid, namely that it is difficult to ensure that it is received by the appropriate group of individuals. We have already suggested that it may be difficult to identify those who should receive such transfers, but even if this problem is solved, ensuring that the transfer actually reaches these individuals will be a further and even more difficult problem.

This discussion is not meant to suggest that the only reason that interregional factor-price differences exist is the Canadian tariff. Indeed subsequent chapters will identify a variety of other reasons why interregional factor returns may differ. Nevertheless it seems clear that a tariff system will generate interregional differences in factor prices, and although tariffs may not be the only cause of such differences, they certainly contribute to the problem. The elimination of Canadian tariffs will almost certainly result in some reduction in the interregional factor-price differences observed at present.

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6 For another explanation of high wages and high rates of unemployment based on unionization see Melvin (1985c).

## 7. INTERREGIONAL FACTOR MOBILITY

There is another important implication of the factor-price differentials associated with tariffs. If factors are free to move among regions, then tariffs, through their effects on real factor rewards, will generate interregional factor mobility. In particular any tariff, no matter on what commodity it is imposed, will result in movement of labour from region W to region E and a movement of capital from region E to region W. Whether one or both factors move, and the extent of the factor movements, will depend on the differences in the mobility of the two factors and on the interregional differential in factor returns.

Perhaps the most surprising feature of such factor mobility is that it will not, at least in the short run, result in any reduction in factor-price differentials among regions. This is a consequence of the Rybczynski theorem (see Appendix A, Section 7), which shows that, as long as commodity prices remain fixed, a change in factor endowments will change commodity outputs but will not change relative factor prices.[7] In this model factor prices are in lock-step with commodity prices, and as long as both goods are produced factor prices cannot change unless commodity prices adjust. We thus have the following proposition.

*Proposition 3.14* With fixed commodity prices, regional factor movements will not result in any tendency towards the equalization of factor rewards among regions as long as both regions continue to export different commodities.

This is a significant result for it shows that factor mobility cannot be counted on to reduce interregional factor-price differences, at least not in the short run. It also provides at least a partial answer to a puzzle that

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7 An important assumption of the Rybczynski theorem is that both regions continue to produce both commodities. Thus we are assuming here that the factor flows are not sufficient to produce specialization. While this is an important qualification it should be noted that the factor flows will not generally produce specialization. Indeed, as will be seen presently, factor flows will make endowments more similar rather than more different.

arises in Canadian public policy discussions. Some researchers have suggested that a solution to the problem of interregional factor-price differences will be sufficient factor mobility, and surprise is expressed when the substantial amount of factor mobility that exists in Canada does not seem to reduce the differentials significantly. In their study of interregional disparities the Economic Council of Canada observes that 'in sum, regional disparities in income and job opportunities are indeed substantial and remarkably persistent in spite of the amount of labour migration that has taken place over the years' (1977, 60). Professor Borts makes somewhat the same observation about the United States economy and notes that for the periods 1919-29 and 1948-52, 'the failure of wages to converge is rather surprising in view of the available evidence that these periods witness considerable inter-state migration from low- to high-wage states' (1960, 163). Proposition 3.14 makes it clear that interregional migration should not be expected to change interregional factor-price differentials.

Proposition 3.14 depends crucially on the condition that commodity prices in the two regions remain unchanged. With enough factor mobility, however, commodity prices in the two regions will be affected, and the changes could lead to the equalization of regional factor rewards. As labour moves from region W to region E and capital from region E to region W the relative endowments of the two regions will become more alike. We have also noted that it is the difference in the regional endowments that gave rise to differences in the trade patterns for E and W. And, of course, it was the differences in trade patterns that resulted in tariffs having differential effects on regional factor returns. As factors continue to migrate in response to factor-price differentials the trade volume for both regions will diminish and eventually trade will be eliminated for one or the other of the two regions (Appendix A, Section 7). Of course, without trade tariffs are not effective and any further factor flows will result in commodity price changes for that region. This change in relative commodity prices will also change relative factor prices and will reduce the differential in factor rewards between the two regions. If there are no impediments to factor mobility then factors will continue to move until commodity prices in the two regions have been equalized, which, in turn, will imply that factor prices are equalized as well. In the final equilibrium factors will have moved in sufficient numbers to make the overall capital-labour ratios in the two regions identical. We therefore have the following proposition.

*Proposition 3.15* With tariffs and with regional trade patterns initially different, factor mobility will equalize regional factor rewards only if trade patterns become the same and if relative endowments are equalized among regions.

Proposition 3.15 shows that if factor mobility is sufficiently large to change the production structure of regions then there will be at least some tendency towards equalization of relative factor rewards across regions. One would never expect complete equalization, however, for just as it is costly to move commodities among regions so is it costly to move factors. Even in the long run factors will not move unless the discounted value of the factor-price differential is at least as large as the moving costs. Thus even if factor mobility does result in some tendency towards regional factor-reward equalization it can never be expected to produce complete equality. Furthermore, requiring such massive factor movements to equate regional factor prices seems particularly inefficient when the same result could be accomplished by the elimination of tariffs.

## 8. FEDERAL VS PROVINCIAL POLICY

To this point the discussion has focused almost entirely on the consequences for federal economic policy of a regional economic model. But regions, or provinces, have policy-making ability in their own right and we now turn to the issue of whether provincial governments could initiate policies that could counteract some of the undesirable consequences of federal action.

Consider the imposition of a tariff on commodity X, the import of region E. We have shown that there are three possible sources of loss for region E associated with such a tariff. First, there is the loss associated with the distortionary price effects of a tariff. Second, there is the loss associated with the fact that the tariff collected will not entirely be returned to the residents of E but will be distributed to consumers throughout the economy. Third, if the tariff is high enough to generate interregional trade there is the loss associated with the wasteful use of resources in providing the transportation for these commodities. Direct policy actions by the government of region E can offset, at least to some extent, the consequences of the first and third. Losses due to interregional trade occur because the tariff rate exceeded the transportation cost. Clearly this interregional trade could be reduced or eliminated by making transportation more difficult. Although direct restrictions

on movements of commodities among provinces would not generally be possible there are many indirect measures that could be used. Most provinces impose licensing fees for common carriers such as trucks, and an increase in these fees would increase the costs of transportation. Higher taxes for gasoline would also be expected to reduce interregional transportation of commodities. Reducing maintenance on highways, and in general the failure to provide an efficient transportation infrastructure, could also be a deterrent to interregional transportation.

Of course, the full gains associated with the elimination of interregional transportation will not be garnered by region E. The gain from the elimination of such wasteful use of resources is essentially the recovery of tariffs, and this tariff revenue will be distributed to all regions. This wide distribution of the gains suggests that provinces have a joint interest in restricting interregional trade, assuming, of course, that the alternative is international trade. Some commentators have observed that in the face of reduced levels of international barriers to trade we observe increases in interprovincial trade restrictions. The implicit or explicit conclusion of such discussions is that such barriers are undesirable. The model we have presented here suggests that such interregional trade restrictions may well be an optimal policy for the provinces, and indeed for the economy as a whole. We thus have the following proposition.

*Proposition 3.16* In the presence of tariff-induced interregional trade, increasing interregional transportation costs may be an optimal strategy for a region or for the economy as a whole.

Of course tariffs and interregional trade restrictions can never be optimal. The first best policy will always be the elimination of both tariffs and interregional trade barriers. The point is that with tariffs in place some interprovincial barriers may increase welfare.[8]

The costs associated with the distortionary effect of tariffs can also be offset, at least in part, by policy

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8 This, of course, is just an application of the second-best argument. Two distortions may be better or worse than one. In the case we have described, two distortions improve the situation.

action of provincial governments. Recall the proposition that for an economy without regions a tariff can be duplicated by a set of purely domestic taxes and/or subsidies. Consider again the case of an import tariff on commodity X that affects region E. The distortionary consequences of this tax can be exactly offset by an equal-rate subsidy for the production of Y combined with a consumption tax on Y (or a subsidy on the consumption of commodity X). If residents in E receive all the revenues from the federal tariff then the combination of the tariff imposed by the federal government and the tax-subsidy program of the provincial government will be completely offsetting and the free-trade position will be re-established. Note also that this policy would also eliminate the possibility of inefficient interregional transportation of commodities. Thus we have the following proposition.

*Proposition 3.17* When faced with a federal tariff on a regional import, the best regional policy will be an offsetting system of regional taxes and/or subsidies.

In general, tariff revenues are not returned to the region from which they were collected, in which case even though the two policies are offsetting in terms of their distortionary price effects, there will still remain a transfer of income from region E to region W. The net taxes and subsidies required for the offsetting provincial action will be just equal to the tariff revenue, and unless all of this tariff revenue is received by region E there will be an interregional income transfer.

Gains from provincial policy action are possible in other circumstances. Consider the case where the tariff in region W, through the generation of interregional trade, actually improved the welfare of region E by improving its terms of trade. In this case it is in E's interest to reduce regional transportation costs rather than increase them, for any such reduction will increase the flow of interregional goods and subsequently further improve the terms of trade. Of course, it is in region W's interest to eliminate this interregional trade, and thus we have a situation where the policy objectives of the two regions are in conflict.

## 9. SUMMARY AND CONCLUSIONS

We began by constructing a model of an economy that consisted of two regions having different factor endowments and with

significant transportation costs between them. It was first shown that one might expect the economy as a whole to be both importing and exporting the two commodities: the phenomenon of cross-hauling. It was also shown that changes in the terms of trade could have different welfare effects on the two regions.

The introduction of tariffs and taxes produced results that differed from those of the traditional trade model. A tariff was shown to result in production inefficiency, and could produce inefficient interregional transportation, which would also reduce welfare. With the generation of interregional trade the economy will switch from collecting tariff revenue to using up resources to produce unnecessary transportation. Indeed Canadian tariff policy seems to have been designed to do precisely this. Tariffs could also result in welfare gains to a region if they result in a reversal of the trade pattern and a switch in trading partners from the rest of the world to the other region. Thus even in a small open economy a region may be better off with a tariff. Taxes were shown to have different consequences for welfare and the volume of trade than in the traditional model, and at the federal level the traditional equivalence between tariffs and a tax system cannot be established.

It was shown that interregional transfers to correct income or welfare differences could result in lower real incomes for all factor owners of the gaining region, raising the question of whether regional incomes or factor incomes should be the appropriate policy target. It was also shown that tariffs could generate differences in factor rewards, and that factor mobility would not equalize these rewards, except in the limiting case where there is enough mobility to equalize relative factor endowments across regions. Thus in an economy with distinct regions subjected to a tariff system, differences in regional factor rewards should be expected to persist, and attempts by governments to equalize regional incomes will almost certainly be unsuccessful.

The consideration of provincial policy led to the conclusion that if tariffs create interregional trade, then increasing interprovincial trade barriers may be an appropriate strategy, both for the province and for the economy as a whole. When faced with federal tariffs, an optimal provincial policy may be the imposition of an offsetting system of taxes and subsidies. Of course distortions at both the federal and provincial levels can never be optimal. The first best policy is the elimination of both tariffs and interregional trade restrictions.

# 4

# An endowment model of regional trade: the short run

The model investigated in Chapter 3 is considered to be a long-run model, for it assumes that factors of production are completely mobile among sectors. The model assumes that any change in commodity prices will result in an immediate shift of both capital and labour to the sector whose price increased. In practice, of course, such adjustments take time, and capital in particular cannot be instantaneously shifted from one use to another. The capital equipment used to produce automobiles cannot be used to dig oil wells or to produce footwear. The process of transferring capital from one sector to another is accomplished by allowing the capital stock in the declining sector to depreciate and transferring new investment to the expanding sector.

The short-run version of the endowment model assumes that capital is fixed in a given sector, or in other words is specific to that sector, and that only labour is free to move between sectors or between regions.[1] Although the long-run implications of the models usually receive most attention, the short-run implications are also important, and indeed may well be the determining issue in whether a particular policy is undertaken. Certainly, understanding the transition between the short and long run will be important for any major policy change.[2]

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1 The short-run model described here is a version of the specific factor model developed by Jones (1971). For the use of the specific factor model as a short-run Heckscher-Ohlin model see Mayer (1974) and Moussa (1974).

2 It is, of course, an oversimplification to assume that there is a simple dichotomy between the long run and the short run, for a variety of intermediate cases could be considered. In the present chapter we assume that capital is specific both to the sector and to the region

There is also the issue of the extent to which short-run adjustments mirror those of the long run. Several kinds of differences may arise. It may be that short-run adjustments are more severe than long-run changes so that initial responses to a policy may overestimate the difficulty of long-run adjustments. Alternatively short-run changes may be smaller than those of the long run, and this may lead to an underestimation of adjustment costs. But whichever is the case it is important to understand these differences in formulating economic policy.

It is also possible that short-run changes may actually be in a different direction than those necessary in the long run, or short-run changes may be indicated while no change is required for long-run equilibrium. In such a circumstance an important policy issue will be whether or not to restrict the kind of adjustment that the short run would suggest in the anticipation that the present allocation of resources will be appropriate when a long-run equilibrium is finally achieved.

These are the questions that are addressed in this chapter. Specifically, a short-run model will be described which will take as its starting-point the long-run equilibrium from the model of Chapter 3. We will then investigate the responses of this model to parameters such as changes in the terms of trade, taxes, and tariffs and compare these with the results found for the long-run model.

## 1. THE BASIC MODEL

The model has the same basic structure as the long-run model of Chapter 3. We assume that two goods, X, and Y, are produced under conditions of constant returns to scale. Two factors, capital, K, and labour, L, are used in the production of both commodities. The model differs, however, in that the capital is assumed to be specific to the sector in which it is located. Thus industry X has a certain amount of capital at the beginning of the period which must be used in

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while labour can move intersectorally or interregionally. One could also consider the case where capital is immobile between sectors but can move between regions. Oil rigs, for example, can be (and are) moved from one region to another. One could also introduce the possibility of international factor mobility.

the production of X, and none of this capital can be transformed into capital useful for the production of Y. In this model capital can be thought of as a specific kind of machine useful for producing only one kind of output.

In other respects the model is identical with that of Chapter 3. The factors of production are assumed to be located in two different regions, and region W is again assumed to be well endowed with labour and region E well endowed with capital.[3] Tastes of the consumers in both regions are identical and homogeneous, and positive transportation costs are assumed to exist between regions and zero transportation costs between the regions and the rest of the world.

The construction of the production possibility curve for a region is straightforward and is shown in Appendix B, Section 1. Of particular interest for the present analysis is the relationship between the short-run production possibility curve defined by the specific factor model and the long-run production possibility curve of Chapter 3. These two curves are shown in Figure 4.1, where $T_E A_E T'_E$ is the long-run production possibility curve for region E shown in Figure 3.1. We assume that a stable, long-run equilibrium has been established so that the economy is in both short-run and long-run equilibrium at point $A_E$. This equilibrium implies a price line P (not shown) tangent to both of the production possibility curves at $A_E$.

Now suppose there is an increase in the price of commodity Y requiring an increase in the production of Y in both the long and short runs. In the long run, with both factors completely mobile, capital and labour will move from the X industry to the Y industry and a new long-run equilibrium will be established at point $A'_E$. In the short run capital cannot move so the increase in the output of Y is constrained to be below the long-run output and will give a new short-run production point $A'_{SE}$. Labour will move from industry X to Y but the output changes generated will be smaller than for the long-run case. Thus in the short run

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3 The endowment comparisons are made on the basis of the long-run capital stocks of the two regions. We begin our analysis in a long-run equilibrium and thus such comparisons of the capital stocks of the two regions can be made (as easily as such comparisons can ever be made, that is).

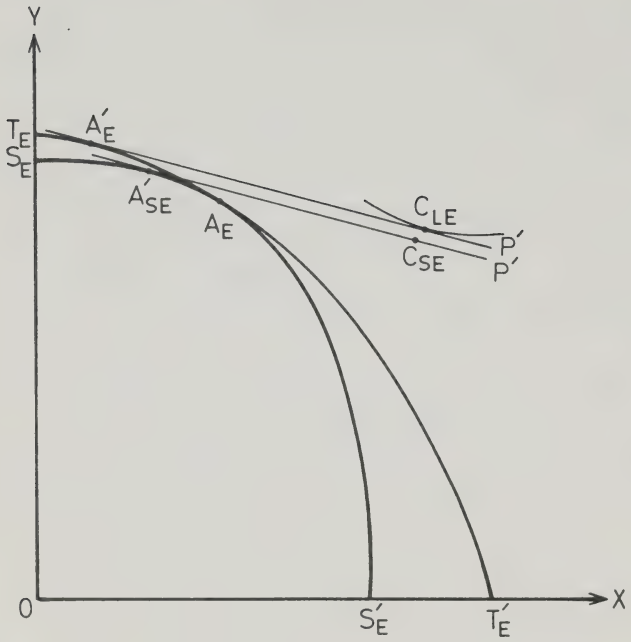


Figure 4.1

the increase in the output of Y and the reduction in the output of X will both be less than in the long run, and we have our first result.[4]

*Proposition 4.1* For a given change in the terms of trade the short-run changes in outputs will be less than the long-run changes.

The short-run production possibility curve for region E shown in Figure 4.1 could be combined with a similar curve for region W and we would have a figure similar to Figure 3.1.[5] Indeed, since the initial short-run and long-run

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4 This is not a surprising result and is an application of the Le Chatelier Principle. For a full discussion of short-run and long-run losses due to distortions see Diewert (1985).

5 This assumes that both regions produce both commodities in the long-run equilibrium.

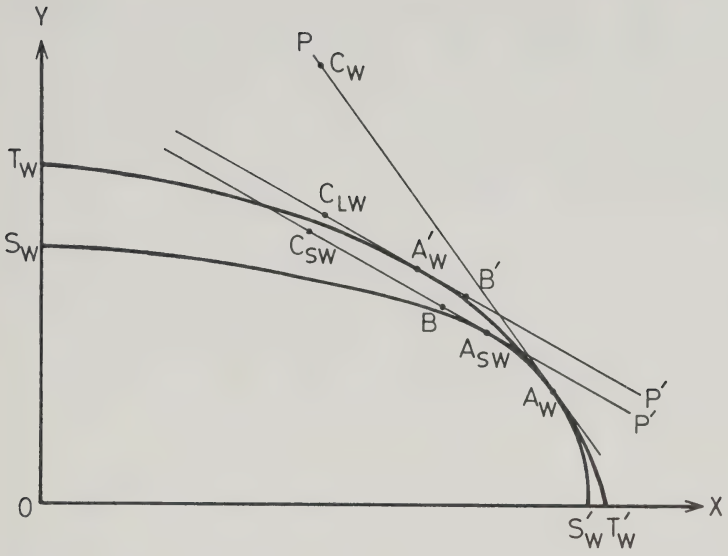


Figure 4.2

equilibriums are identical, trade volumes and the patterns of trade for the two regions would also be identical. It follows immediately that Proposition 3.1 applies equally well to this short-run model.

With point $A_E$ the initial equilibrium in Figure 4.1, the increase in the relative price of Y from P to P' allows us to compare the short-run and long-run effects of changes in the terms of trade. Two points are immediately clear. First, the long-run welfare gains are larger than the short-run gains. Second, the long-run change in the volume of trade is larger than the short-run change. For region E the short-run equilibrium is between the two long-run equilibria so that in the short run utility will increase to $C_{SE}$ and will increase further to $C_{LE}$ when the long run is achieved.

The situation is somewhat different for region W, however, as is shown in Figure 4.2. In the initial equilibrium with prices P the long-run production and consumption points are $A_W$ and $C_W$ respectively. An increase in the price of Y to P' will produce long-run and short-run production points $A'_W$ and $A_{SW}$. The long- and short-run consumption points will be $C_{LW}$ and $C_{SW}$ respectively. We see that for region W the short-run welfare or income adjustment is larger than is required in the long run, so that this region overshoots in the short

run. We also note that with a deterioration in the terms of trade, the volume of trade will be larger in the short run than in the long run. The short-run volume of trade is strictly between the two long-run trade volumes for both region E and region W. Thus the trade volume moves smoothly and monotonically between the two long-run equilibria even though welfare may not. We thus have a short-run counterpart to Proposition 3.2.

*Proposition 4.2* If regional trade patterns differ, an improvement in the terms of trade for the economy as a whole will increase welfare in one region and reduce it in the other. The welfare gains will be smaller and the losses larger in the short run than in the long run. With respect to the volume of trade, the short-run equilibrium lies strictly between the two long-run equilibria.

For a terms-of-trade change, then, the gaining region moves monotonically to a higher welfare level, while the losing region suffers a large initial loss but then recoups some of the loss in the long run. This adjustment to long-run equilibrium is quite satisfactory for region E but clearly less so for region W. The fact that the short-run losses for region W are larger than the long-run losses certainly suggests that consideration be given to short-run interregional transfers. We will have more to say on this question when the effects of changes in the terms of trade on factor returns are considered.

It is interesting that the direction of trade may even differ between the long run and the short run for region W. Suppose, in Figure 4.2, that tastes were such that with prices P' the long-run consumption point was B' with short-run consumption at B. The long run implies exports of Y and the short run exports of X. And, of course, at some point in the adjustment process there will be no trade.

## 2. THE EFFECTS OF TARIFFS

Many of the consequences of the imposition of tariffs in this short-run model follow immediately from the analysis of Chapter 3. Since both goods are imported a tariff can be imposed on either X or Y (or both), and because of our assumption of interregional transportation costs, tariffs will only affect the region that is importing the tariff-ridden commodity. The relationship between the long-run and

short-run costs of a tariff are examined in Appendix B, and somewhat surprisingly we find that the short-run effects may be smaller than the long-run effects. Thus a tariff may reduce income less in the short run than in the long run. This effect is, of course, opposite to what was found for a deterioration in the terms of trade. The reason for the difference is that with a tariff there are two countervailing effects. The short-run terms-of-trade effect associated with the fact that the domestic price of the import has increased suggests that the short-run loss will be larger. At the same time, however, the short-run production change is less, which in turn implies that the short-run change in the volume of trade will be less, and this generates larger short-run tariff revenues. Which of these effects will dominate is indeterminate unless the production functions for both commodities are fully specified. We thus have the following proposition.

*Proposition 4.3* A tariff will affect only the region importing the tariff-ridden commodity, and the short-run welfare loss may be larger or smaller than the long-run loss.

While the relative sizes of the long- and short-run effects of a tariff are indeterminate because of the offsetting nature of the terms-of-trade effect and the volume-of-trade effect there is no ambiguity about the relative size of the tariff revenues. As mentioned, trade volume in the short run is larger and therefore tariff revenues are higher. If these tariff revenues are distributed to all consumers in the economy then the short-run benefits for consumers in the region not affected by the tariff will necessarily be higher than the long-run benefits, and thus, in addition to Proposition 3.4, we have the following proposition.

*Proposition 4.4* The gain to the residents in the region where the tariff is not effective will be larger in the short run than in the long run.

Proposition 4.4 suggests that there may be short-run benefits to encouraging the government to impose tariffs on the imports of other regions. It is possible to have a situation where long-run costs are high but where short-run benefits to the non-tariff-ridden region are also high. And

it is generally recognized that tariffs are a long-run phenomenon, for while easily imposed they are removed with much more difficulty.

Finally it is of interest to note that the dead-weight loss referred to in Proposition 3.5 will be smaller in the short run than in the long run. This result is most easily demonstrated by noting that the less substitution there is in production the smaller will be any losses associated with price change. In the limiting case where there is no substitution in production all costs of tariffs are borne by consumers and there is no production cost whatsoever. We therefore have the following proposition.

*Proposition 4.5* The dead-weight production loss of tariffs is smaller in the short run than in the long run.

## 3. INTERREGIONAL VS INTERNATIONAL TRADE

As the tariff rate is increased in this model we will find, following the argument of Chapter 3, that at some point tariffs will become higher than interregional transportation costs. Again there will be a welfare loss associated with the switch from international trade on which tariffs are collected to interregional trade which uses up resources to provide transportation. As has already been observed, with any tariff the short-run volume of trade is larger than the long-run volume of trade, and thus the short-run tariff revenue is larger than the long-run tariff revenue. This volume-of-trade effect has two important implications. First, in the short run the volume of interregional trade required for equilibrium will be larger than necessary in the long run. Second, the use of resources to provide this transportation will be higher in the short run. We thus have the following proposition.

*Proposition 4.6* The short-run welfare costs of interregional trade generated by tariffs are larger than the long-run costs. Furthermore the short-run volume of interregional trade will be larger than required in long-run equilibrium.

This comparison is of some significance for it suggests that the transportation facility required in the short run to accommodate interregional trade will be larger than required in the long run. Transportation facilities, however, are almost always long run in nature, so that a

transportation network that would facilitate short-run requirements would be too large for long-run needs. Responding to short-run transportation requirements can therefore result in an overbuilding of the transportation network.

A comparison of Propositions 4.3 and 4.6 is of interest. While the short-run cost of a tariff will be expected to be less than the long-run costs, if the tariff generates interregional trade, the short-run costs will be larger than the long-run costs. Tariffs which result in interregional trade are particularly harmful in the short run.

We have shown that with tariffs the short-run volume of trade will be larger than the long-run volume of trade. Proposition 3.7 argued that in a regional economy the existence of tariffs destroys the predictive power of the Heckscher-Ohlin theorem. This situation is exacerbated when the short- and long-run situations are compared because just as the volume of trade may differ in these two situations so may the pattern of trade. Thus the shift from the short run to the long run could also change the pattern of trade, and we have the following proposition.

*Proposition 4.7* For a regional economy tariffs may result in distinctly different patterns of net trade in the short and long run.

## 4. GAINS FROM REGIONAL TERMS-OF-TRADE CHANGES

Proposition 3.9 showed that a tariff that is high enough to generate interregional trade could create excess demand in the non-tariff region and thereby improve that region's terms of trade. This terms-of-trade change would result in a higher level of utility and per capita income for the non-tariff region. The same result will hold in the present model, the difference being only that the short-run and long-run changes will not be the same. As is clear from previous arguments the volume of trade in the short run is larger than in the long run. This fact implies that the region affected by the tariff will, in the short run, wish to purchase more of the imported commodity from the other region. If it does so, the result will be a terms-of-trade improvement for the non-tariff region that is larger in the short run than in the long run. Furthermore, given that the volume of trade for the tariff-ridden region differs in the long and the short run, one could have a change in the economy's pattern of trade as one moves

towards the long-run equilibrium. We therefore have the following proposition.

*Proposition 4.8* The terms-of-trade improvement in the non-tariff region associated with the generation of inter-regional trade will be larger in the short run than in the long run. The pattern of trade for the non-tariff region may be reversed both by the terms-of-trade change and by the movement from the short run to the long run.

There are several implications of this proposition. First, it is somewhat disconcerting that the short-run gains to the non-tariff region are larger than are the long-run gains, for this may prompt undesirable policy action. A corollary to Proposition 4.8 is that even though there may be no long-run gains for the non-tariff region there may be short-run gains associated with the larger interregional demand for its products. While there will be no long-run incentive for the non-tariff region to encourage the federal government to impose tariffs on the imports of the other region, there will be a short-run incentive for it to do so.

Second, the fact that trade patterns can be switched both by a tariff that generates interregional trade and by the movement from the short run to the long run could also result in costly and unnecessary short-run adjustments. Suppose the short-run equilibrium requires region E to switch from exporting X to exporting Y but that in the long run commodity Y again becomes the export commodity. Unless the transportation facilities for these two commodities are identical the switch from one to the other to accommodate short-run demands will be costly. It may therefore be in society's interests to restrict the amount of short-run adjustment.

## 5. TAXES AND TRADE

The main results from Proposition 3.9 carry forward for the short-run model considered here. As in Chapter 3 the differences between taxes and tariffs arise because taxes imposed at the national level affect both regions while tariffs affect only the region importing the commodity on which the tariff was imposed. And as was the case in earlier sections of this chapter the differences in the short- and long-run results depend mainly on the fact that the short-run volume of trade is larger than the long-run.

One important difference is the effect that taxes have on the region that imports the commodity on which the production tax is imposed. As is shown in Appendix B, Section 4, a production tax on Y in region W acts as an export subsidy and increases the production of X. The short-run change in output will be smaller than the long-run change, and since the output change increases exports, the volume of trade in the short run will be smaller than in the long run - opposite of the case for a tariff. One implication of this is that the short-run welfare costs of an export subsidy (or a production tax on the import good) will necessarily be less than the long-run cost, and in this case we have a situation where the short-run welfare equilibrium lies between the two long-run equilibria.

Because a tax system that acts as a tariff in one region and as an export subsidy in the other has larger short-run trade effects in the former than in the latter, we again have the possibility that the economy-wide pattern of net trade will change between the short run and the long run. This possibility is more likely in the tax case simply because both the short-run changes in the two regions operate to produce this result. We thus have the following proposition.

*Proposition 4.9* A national tax structure will increase trade in one region and reduce it in the other in both the short and long run. The move from the short-run to the long-run equilibrium may change the overall pattern of trade for the economy.

## 6. REGIONAL ECONOMIC POLICY

Comparisons between the short-run and long-run versions of the endowment model have, to this point, been quite straightforward. The main differences have been quantitative, and in particular the fact that in the short run production changes have been smaller and trade volumes larger has been the key difference. Through the previous sections of this chapter attention has focused on outputs, or final good parameters, of the model. It is now time to turn our attention to the inner workings of the model and focus on factor prices and factor movements. It is with respect to these variables that the short-run model differs most markedly from the long-run version.

In one respect the specific factor model considered here is simpler than the endowment model in which all factors are

assumed to be mobile. With capital specific to each sector in each region we need only concern ourselves with the movements of labour. Of course, the short-run returns to capital will change and these will have important implications for long-run adjustments, but in the short run it is the wage rate that will be of most interest, for this will determine the intersectoral and interregional movement of labour.

Unfortunately, having a single mobile factor of production does not simplify the analysis. In fact, since all adjustments must come about through labour mobility, the analysis becomes more complex and less predictable. To take an example that anticipates subsequent results, in the long-run endowment model with both goods produced in both regions commodity prices uniquely determine relative factor prices. In the short-run model no such simple relationship exists. The return to labour, as well as being a function of commodity prices, is also affected by factor supplies. Thus interregional movements of labour will change the wage rate in both regions, so that in the short run labour mobility will tend to equalize interregional wage rates. Recall that this is not true for the long-run model.

The first task is to investigate the relationship between the wage rate and parameters of the model such as commodity prices and endowments. It is important to recall that, as a starting-point for the discussion of this model, we took an equilibrium from the long-run model of Chapter 3. In any such equilibrium, because of the complete mobility of all factors, we have equalization of real and relative factor prices both intersectorally and interregionally. Thus in the initial situation, with the same commodity prices facing producers in both regions, we will have the same initial wage-rental rates and the same real returns to factors. A diagrammatic representation of the relationship between outputs, inputs, factor prices, and commodity prices is presented in Appendix B, Section 5.

Proposition 3.2 noted that, with regions exporting different commodities, a change in the terms of trade would make one region better off and the other worse off. It was further observed that although such price changes resulted in changes in the real returns to the factors of production, these changes were identical across regions. Thus an increase in the price of commodity Y increased the return to capital and reduced the return to labour but did not create differences in factor prices between the two regions. In the

specific factor model the results are quite different. Indeed there are two quite distinct ways in which the results of these two models can be contrasted. Consider first a relative increase in the price of Y, which, of course, implies a relative fall in the price of X. It is well known (and is shown diagrammatically in Appendix B, Section 5) that in the specific factor model the real return to the mobile factor will always change by an amount that is between the changes in the two commodity prices.[6] Thus labour will be better off with respect to commodity X and worse off with respect to commodity Y, and whether labour is absolutely better or worse off depends on which of these two commodities is important in the utility function of the worker. Thus the first difference is that a change in commodity prices does not give a clear indication of whether labour will be better off or worse off. This result is in sharp contrast to the long-run model, where an increase in the price of Y will unambiguously make labour worse off in both regions.

Note that the ambiguity here concerns labour's welfare under the two commodity price regimes, and we have argued that we cannot predict how labour will fare when prices change. A more crucial question for the issue at hand is whether we can compare how labour's return will be affected across regions. It is here that the second difference referred to above arises, for it can be shown (see Appendix B) that with an increase in the price of Y labour in region E will unambiguously be made better off than labour in region W. The technical reasons for this difference are quite complex but an intuitive explanation can be provided. In region E production of Y is accomplished through the use of a large amount of capital that is specific to that sector. With a change in the price of Y the change in the labour input required to produce the larger output does not much reduce the marginal product of labour, or to be more precise, reduces the marginal product of labour less that it does in region W which has a relatively smaller amount of the required capital. It is the marginal product of labour that determines the wage rate, and thus we have the result that in industry Y the wage rate is not reduced by as much in region E as it is in region W. An exactly analogous

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6 For a mathematical derivation of these results see Jones (1971).

argument shows that in the X industry, because of the relatively smaller amount of capital specific to that sector in region E, the marginal product of labour is increased by more than it is in region W. These two results combine to imply that an increase in the price of Y makes labour unambiguously better off in region E.

It can also be shown that the argument is completely symmetrical with respect to an increase in the price of X. In this case region W has a relatively large amount of the specific factor used in producing X and thus the reallocation of labour does not require as much of a reduction in the marginal product of labour in W as it does in E. A similar argument applies for industry W, and we reach the conclusion that with an increase in the price of X, labour in region W is made better off than labour in region E. This is a striking result for it shows that any relative commodity-price increase will make labour better off in the region that produces relatively more of that commodity. The returns to labour depend not on the relative factor intensities of the industries (as in Chapter 3) but on the relative importance of the industries in regional production. Thus we have the following proposition.

*Proposition 4.10* In the short run a commodity price increase will make labour relatively better off in the region that has a comparative advantage in the production of that product.

Proposition 4.10 makes it clear that the results of Proposition 3.11 concerning the effects of transfers in response to terms-of-trade changes are not true in the short run. Indeed in the short run it would be quite appropriate to provide transfers from the region that is made better off to the one that is made worse off, at least if one is concerned with interregional equality of the returns to labour. And because of the symmetry of the specific-factor model there is never any doubt as to what form the transfer should take. Labour is always made worse off in the region that is disadvantaged, and thus the transfer should always be to labour in that region. There will, of course, be problems in distinguishing between the long run and the short run, and of course there may well be better adjustment methods than interregional transfers.

Because price changes result in different wage rates between regions there will be an incentive for factors to

move. As is shown in Appendix B, Section 5, a modest amount of factor mobility will re-establish equilibrium between the wage rates of the two regions. In particular, it can be shown that the interregional movement of labour required to equalize wage rates will be of the same order of magnitude as the amount of intersectoral labour movement associated with the price change. Thus the movement of the labour displaced in the industry in the disadvantaged region to the expanding sector of the advantaged region will generally be sufficient to bring about interregional wage equalization. Here again the short-run analysis is in sharp contrast to the long-run results of Chapter 3. Thus we have the following proposition.

*Proposition 4.11* Changes in the terms of trade will generate interregional labour flows that will eliminate wage-rate differentials. The interregional migration required will be of the same order of magnitude as the intersectoral factor flows associated with the price change.

Tariffs affect commodity prices in the region importing the commodity on which the tariff is imposed, and in Chapter 3 we found that any tariff will produce interregional differences in factor returns. By Proposition 3.13, any tariff will harm the abundant factor of each region. The short-run, specific-factor model produces quite different results. First note that, just as in the long run, a tariff only affects the region that imports a commodity. Furthermore a tariff is equivalent to a deterioration in the terms of trade in so far as the effects on factor returns are concerned. It was argued above (and is shown in Appendix B, Section 5) that the effect of relative price changes on the real return to labour is ambiguous. Labour will gain relative to the commodity whose price has fallen and lose relative to the commodity whose price has increased. It can be shown, however (see Appendix B), that although a tariff can make labour better or worse off, there is a presumption that labour will lose.[7] Note that this presumption is entirely in terms of the returns to factors and leaves aside the issue of the redistribution of tariff revenues. To simplify the analysis we make the assumption that tariff revenues are distributed equally to all individuals in the economy.

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7 On this point see Ruffin and Jones (1977).

The presumption that a tariff will make labour worse off is general and does not depend on which commodity is subjected to the tariff. There is, therefore, a presumption that a tariff on X will make labour in W worse off and that a tariff on Y will make labour in E worse off. Thus the short-run effects of a tariff structure, unlike the results of Chapter 3, provide no predictions about interregional returns to labour. Note, however, that with only one tariff there is a presumption that labour in the tariff-ridden region will be made worse off and will therefore migrate to the other region. And again, as was true for terms-of-trade changes, a relatively small interregional labour movement will eliminate the interregional difference in utility levels.

## 7. FEDERAL VS PROVINCIAL POLICY

The distinction between the short run and the long run does not affect much the conclusions about the interaction of federal and provincial policies. It will still be the case, as was suggested in Proposition 3.17, that an offsetting tax and/or subsidy program for the provincial government could effectively counteract federal tariff policy. Proposition 3.16 suggested the use of higher transportation costs to inhibit interregional trade flows, thereby increasing the welfare of both regions (and the economy as a whole). We have found that the short-run interregional flows associated with tariffs will be even larger than those in the long run so that such policies will be even more attractive in the short run. Indeed, as has already been suggested, there may be significant benefits to restricting short-run commodity flows if such flows would necessitate the establishment of a transportation system that would not be required in the long run.

## 8. SUMMARY AND CONCLUSIONS

This chapter had two goals. The first was to investigate the implications for regional analysis of a model in which there are factors that are specific to the two industries. The second was to compare the results of this model with the analysis of the endowment model described in Chapter 3. One interpretation of the specific-factor model is that it is a short-run version of the long-run Heckscher-Ohlin model. In terms of the output effects of such things as changes in the

terms of trade it was found that the principal differences between the two models were quantitative. It was shown that any given change in the terms of trade, while changing outputs in the same directions, would produce a smaller change in output in the short run than in the long run.

The effects of terms-of-trade changes were seen to depend on whether they represented an increase or a reduction in the price of the region's exports. It was shown that with a deterioration in the terms of trade the short-run welfare loss would be larger than the loss associated with a new long-run equilibrium. For an improvement in the terms of trade the short-run loss would be less. These effects suggest that intersectoral transfers of incomes might be made to smooth the adjustment path for the disadvantaged region.

The imposition of tariffs has many of the same consequences as were described in Chapter 3. Only the region importing the commodity on which the tariff is imposed will be affected directly, but the other region may gain from such a tariff if tariff revenues are distributed to all consumers in the economy. It was found, however, that the short-run effects of a tariff can be either greater or smaller than the long-run effects, depending on the relationship between the terms-of-trade effect and the volume-of-trade effect. One important result was that the short-run tariff revenue will be larger than the long-run revenues, and if this revenue is distributed to all consumers in the economy it provides an incentive for regions to encourage the federal government to impose tariffs on commodities imported by other regions.

As was the case in the long run, a tariff may encourage unnecessary interregional transportation. Furthermore, the amount of interregional transportation required in the short run may be substantially larger than required in the long run, leading to the possibility that transportation facilities might be overbuilt in the short run. In addition, because the amount of interregional trade is larger in the short run than in the long run, the short-run losses associated with this trade are also larger. Government policy to restrict such interregional trade, particularly in the short run, may result in substantial welfare gains. It was also found that the long-run and short-run trade patterns could differ, which could be important if different commodities require substantially different transportation facilities.

More substantive differences between the two models were found when attention was focused on the effects of price changes on factor prices and factor mobility. It was shown that the effects of a relative price change on the return to labour, the mobile factor, were ambiguous, and depended on the preferences of workers. This result is in sharp contrast to that of the long-run endowment model, where relative price changes have unambiguous effects on the returns to factors of production.

Of even more significance is the fact that a relative commodity price change that affects both regions results in different wage rates, and in particular there is a presumption that labour will be relatively better off in the region that exports the commodity whose price has risen. With interregional factor mobility the implication is that any commodity price change will result in a movement of labour from the disadvantaged to the advantaged region. It was also shown that the amount of labour required to re-equilibrate wages between the two regions was not large, and was of the same general magnitude as the intersectoral shift of labour required by the production changes associated with the terms-of-trade change. This result implies that the factors dislocated in one region by the reduction in the output associated with relative price changes could move to the other region and the move would be sufficient to equalize regional wage rates. This result is again in sharp contrast to the long-run model where factor mobility will not result in the equalization of interregional factor prices unless it also results in the equalization of overall capital-labour ratios.

# 5

# Regional trade with increasing returns to scale

The endowment models of Chapters 3 and 4 made the traditional assumption of constant returns to scale. This was a convenient simplification for a variety of reasons. Models that assume constant returns to scale, because of their simplicity, are easy to analyse and generally provide clear results and unambiguous policy conclusions. They also provide a convenient terms of reference against which other more complex models can be compared. Furthermore, when investigating the effects of differences in endowments in a regional model it is convenient to abstract from other differences which, by themselves, could give rise to trade. Thus if one were to assume both increasing returns to scale and endowment differences it would be virtually impossible to separate the effects of the two factors, which would make it difficult to reach definitive conclusions about trade flows or about appropriate policy actions.

But while the constant-returns-to-scale model is convenient and instructive, there is a significant amount of evidence suggesting that, particularly for the Canadian economy, increasing returns to scale are an important feature affecting international and interregional flows of commodities and factors. It has long been maintained that one of the principal reasons that certain industries in the Canadian manufacturing sector have not been able to compete successfully in world markets is their inability to achieve scale economies. It is argued that Canadian firms produce too many different varieties and that the production runs are too short, giving rise to higher average costs than prevail in the United States and other internationally competitive markets. Recent work by Harris and Cox (Harris 1984a) suggests that the principal benefit to be gained by Canada from free international trade would be the

rationalization of Canadian industry, which would allow it to take advantage of the economies of scale that the small market size now precludes.

This chapter analyses a regional model with increasing returns to scale. To focus attention on the effects of scale economies, and to ensure that the results we derive are a consequence of increasing returns to scale and not due to other differences, we neutralize the other variables that could give rise to international or interregional trade. In particular, we initially assume that there are no tariffs, taxes, or other distortions, and that all individuals have identical and homothetic preferences. The consequences of assuming differences in the interregional endowments of capital and labour were analysed in Chapters 3 and 4, and to abstract from these we assume that the two regions possess factors of production in the same proportions.

In models with increasing returns to scale relative size is an important determinant of trade flows and factor prices. It is also clear that regions in Canada differ significantly in size (that is, in their absolute endowments of factors of production). Thus an important feature of our model will be the assumption that the two regions considered differ significantly in size.

One of the difficulties in analysing models that incorporate increasing returns to scale is that there are many different variants of the model that could be examined. There is, first of all, the question of the source of the scale economies. Two sources of returns to scale are typically identified: economies that are external and economies that are internal to the industry being considered. External economies refer to those characteristics of industries which, while providing an overall benefit to firms, cannot be internalized or captured by individual producers. These would include the existence of infrastructures such as roads and rail systems which facilitate the movement of factors and commodities. Also included would be efficient communication systems or the existence of pools of skilled labour or other specialized factors which can be drawn on by all firms within the industry.

Internal economies refer to production advantages that are specific to individual firms and that can be characterized by declining average-cost curves. These are internal because the advantages can be captured by the individual firm and need not be shared with other producers, either existing or potential. They might be associated with better

technology, patents that prevent other firms from entering, or simply more highly skilled management. These economies typically provide an advantage that allows the firm to expand output and, at the same time, to sell at prices above average cost. The advantages of increasing the level of output typically mean that internal economies and perfect competition cannot exist simultaneously.

The external-economy model is the one traditionally analysed in international trade discussions. It has the advantage that it allows the introduction of scale economies while at the same time making it possible to maintain the assumption that individual firms are perfectly competitive. With external economies all individual firms in an industry are assumed to behave as perfect competitors who do not, in their individual decision-making, take into account the fact that there are externalities at the industry level. These assumptions permit the use of the standard theoretical models employed in Chapters 3 and 4.

The assumption of internal economies presents more difficulties, for as has been suggested it is typically not consistent with the assumption of perfect competition in the product markets. If average cost is downward sloping marginal cost will always be less than average cost and the perfectly competitive assumption that price is equal to marginal cost would require that all firms take a loss on all units of output. The alternative is to assume a non-competitive market structure such as monopoly, oligopoly, or monopolistic competition. While the monopoly model can be handled with a minimum of difficulty, general-equilibrium discussions in which there are oligopolies or in which firms behave as monopolistic competitors are very complex and generally do not provide tractable analytical models. The case where internal economies lead to monopoly is analytically similar in many respects to the case where there are external economies of scale. It is therefore these two cases that we will consider for the remainder of this chapter.

In models where there are increasing returns to scale another crucial assumption is how these returns to scale differ between the two industries. This is an important question because it is the relationship between the degrees of homogeneity, or in other words the extent to which there are increasing returns to scale, that will determine the relationship between commodity prices and the rate of product transformation (the slope of the production possibility curve). In general, with returns to scale,

equilibrium is not characterized by a situation where the commodity price line is tangent to the production possibility curve. The wedge between the slope of the production possibility curve and the commodity price ratio at equilibrium is determined by the degrees of returns to scale in the two industries. Loosely speaking, we can say that the higher the returns to scale in one industry the higher will be the price of that commodity relative to the marginal rate of transformation. Thus if returns to scale are higher in the X industry than in the Y industry the slope of the commodity price ratio (that is the relative price of X in terms of Y) will be steeper than the slope of the production possibility curve at the equilibrium production point. Two special cases are easily identified and are commonly analysed: the same degree of returns to scale in both industries, and increasing returns to scale in one industry and constant returns to scale in the other. We will consider the first of these briefly and the second in more detail.

## 1. INCREASING RETURNS TO SCALE IN BOTH INDUSTRIES

As before we assume two commodities, X and Y, both produced using two factors of production, K and L. Capital and labour are assumed to be in fixed supply for the economy as a whole. It is assumed that the economies of scale in both industries are large enough relative to factor intensity differences to give the production possibility curve TAT' of Figure 5.1. Given the assumption that the two regions differ only in size, the production possibility curves for the two regions will look exactly alike except that one will be farther from the origin. Thus Figure 5.1 could represent either region (or both).

For a region not engaged in trade the autarky equilibrium point would be A, where a community indifference curve is tangent to the production possibility curve. Suppose now that the region (assumed to be small) is faced with a commodity price ratio P given from outside. Note that even if this P is identical with the one that would have prevailed in autarky the region can still gain from trade by specializing in either commodity X or Y. In general we would expect the difference between the autarky prices and the prevailing world prices to determine in which commodity the region would choose to specialize. If world prices for commodity X are higher, when trade is allowed we would expect the X industry to expand, and it would continue to do so until specialization occurs at point T'.

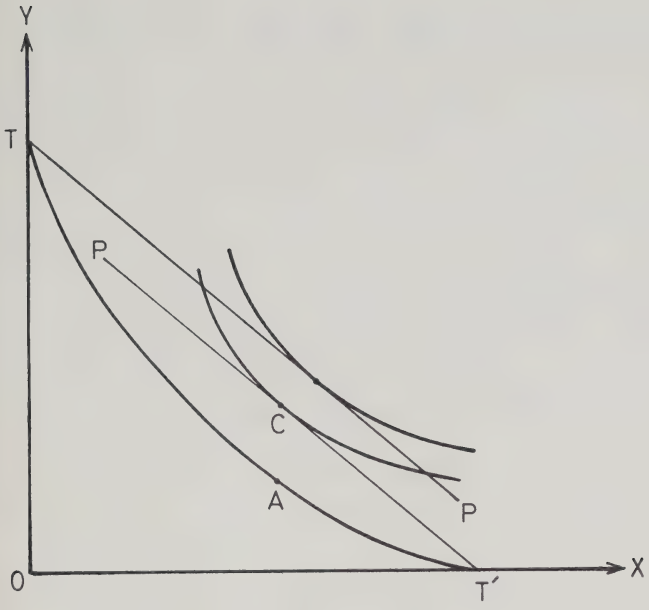


Figure 5.1

The model has a number of interesting characteristics. As we have already seen, allowing trade for a small region (or for a small country) will result in specialization. As Figure 5.1 has been drawn, specialization in either commodity will result in gains, but it is not a matter of indifference whether X or Y is produced. In Figure 5.1 the world price line P implies a higher price for X than existed in autarky and thus this region specializes in X. Note, however, that specialization in commodity Y and production at point T at the same prices would have resulted in a higher level of welfare for this region. Production at either T or T' will be an equilibrium, and when one of these production points has been reached there will be no tendency for the region to move away from that equilibrium.[1] In general, in models where trade results in specialization, there is a degree of arbitrariness on the production side. Either good may be produced, and the choice may or may not be the appropriate

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1 It is assumed here that there is no factor mobility. The consequences of factor flows are considered in Section 4 of this chapter.

one from the point of view of the welfare of the region as a whole. Thus we have the following proposition.

*Proposition 5.1* With strong increasing returns to scale in all industries there is a presumption that there will be specialization in production. There is also a fundamental indeterminacy in which good will be produced. Regional welfare will generally depend on the choice.

While there is indeterminacy on the production side, it is certainly possible that in equilibrium the two regions will have different trade patterns. Thus in Figure 5.1 region E could produce at T and export Y while region W produces at T' and exports X. In such a case several propositions from previous chapters follow immediately. For example, we have cross-hauling of identical commodities for the economy as a whole, and terms-of-trade changes affect the two regions differently.

Figure 5.1 shows that although it does matter in which commodity a region specializes, it will nevertheless gain relative to the autarky point A whichever good is produced. Indeed the gains can be quite substantial, and in general the potential gains associated with trade in models in which there are increasing returns to scale are significantly larger than in the traditional models with constant returns to scale. Total output for the economy as a whole will generally be increased if each region is able to specialize in only one good rather than producing some of both.

But while potential gains from trade with increasing returns to scale are large, gains from trade for an individual region cannot be guaranteed. In Figure 5.1 with a region specialized in X, suppose that, over time, the price of Y rises substantially. Such a price change would produce a deterioration in the terms of trade and, if large enough, could actually make the region worse off than it was at autarky (see Melvin 1969). Thus with increasing returns to scale gains from trade for a region or a country are not guaranteed, and we have the following proposition.

*Proposition 5.2* With increasing returns to scale potential gains are large, but trade gains for an individual region (or for a country) cannot be guaranteed.

If we assume that our two regions are exactly the same size, then the locus TAT' could represent the production possibility curve for both. With world prices given by P,

there are four possible output configurations for the country as a whole: both regions can specialize in Y, both could specialize in X, or they could specialize in different commodities. This indeterminacy in production would also produce an indeterminacy in trade patterns, for we could import only X, import only Y, or import both. And, of course, this indeterminacy in production will produce an indeterminacy in the effects of terms-of-trade changes. If the two regions specialize in different commodities then we will have results similar to Proposition 3.1. Any change in world prices will make one region better off and the other worse off, but in this case there will be no a priori way of knowing which region will gain and which will lose. Alternatively, if both regions produce the same commodity then they will both be affected in the same way by a terms-of-trade change.

If trade results in complete specialization as in Figure 5.1 then changes in commodity prices, associated for example with terms-of-trade changes or with the imposition of tariffs, will affect consumers but will have no effect on production. This absence of a production response has two important consequences. First, tariffs that do not affect the composition of output will produce smaller welfare changes than will tariffs in the model of Chapters 3 and 4 where production varies with price. However, if the tariff is high enough to generate interregional trade then the welfare costs can be significantly higher than in the model with constant returns to scale. This higher cost is essentially due to the fact that with increasing returns to scale the volume of trade will be large and therefore the consequences of shifting trade partners and giving up the benefits of free trade can be very significant.

These points are illustrated in Figure 5.2. It is assumed that with free trade the region is specializing in commodity Y at point T and consuming at point C at prices P. A 50 per cent tariff on commodity X, the import good, would not affect production but would move consumers to $C_t$, assuming that the tariff is not as high as the transportation costs between our two regions. Thus we have the following proposition.

*Proposition 5.3* When increasing returns to scale result in complete specialization, tariffs will not change production, and will have less serious welfare consequences for the economy than when constant returns to scale are assumed, as long as trade patterns are unaffected.

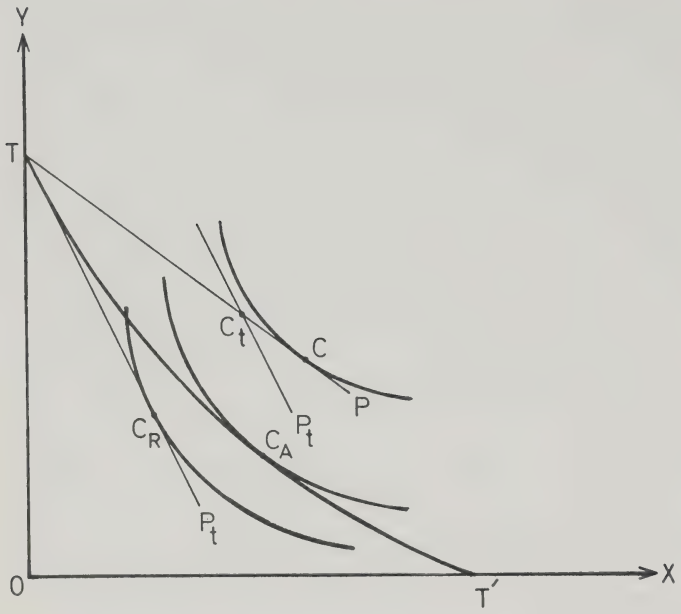


Figure 5.2

But now suppose the tariff that gave rise to prices $P_t$ is marginally larger than the transportation cost (or alternatively suppose that transportation costs have fallen slightly) so that this region now chooses to import from the other region rather than from the rest of the world. The tariff formerly collected on imports will now be lost and used up to provide transportation. Consumers will now move to point $C_R$ on the price line $P_t$ through point T. The loss associated with the switch to interregional trade is substantial; indeed the region has been placed in a position where it is incurring large losses from trade rather than gains. Welfare would be substantially increased if interregional transportation costs could be raised sufficiently so that trade with the rest of the world could be re-established with consumption at $C_T$. In fact, complete isolation and no trade would be preferable to the interregional trading situation, for the autarky position $C_A$ clearly dominates $C_R$. We therefore have the following proposition.

*Proposition* 5.4 Tariffs that generate interregional trade may have much more serious welfare consequences in models

that are characterized by increasing returns to scale. The resulting interregional trade may be worse than no trade at all.

In recent years in Canada a good deal of attention has been paid to the question of the effects of interprovincial barriers to trade, and several attempts have been made to estimate the costs of these barriers. The analysis here suggests that in some circumstances interprovincial trade barriers may be a significant benefit rather than a cost. There may well be circumstances in which interprovincial trade barriers are too small.

Tariffs leading to consumption at point $C_t$ in Figure 5.2 implicitly assume that the entire tariff revenue is redistributed to consumers of this region. But, as we have argued previously, such a redistribution is not to be expected in a regional economy where tariffs are imposed by the federal government. With tariff revenues being distributed to all consumers in the economy, consumers in the tariff-ridden region will find themselves somewhere between points $C_R$ and $C_T$. It is therefore possible that the complete elimination of trade with consumption at point $C_A$ would dominate tariff-ridden trade with the rest of the world. This result would occur if after the distribution of tariff revenue the region was at some point below the indifference curve through $C_A$. Furthermore, large tariff revenues can lead to substantial gains for the other region if tariff revenues are shared. Thus we have the following proposition.

*Proposition 5.5* With increasing returns to scale and specialization, the gains for a region associated with the imposition of a tariff on the imports of another region may be substantial if all consumers in the economy share in tariff revenues.

This result obviously depends on the implicit assumption that the two regions have different trading patterns. Note also that the result from earlier chapters that a tariff only affects the region importing the commodity is true here as well. However, there is no dead-weight production loss associated with a tariff in this model, since production is unaffected.

Several of the propositions from earlier chapters concerning trade in a regional economy follow immediately in this model, and do not require elaboration. Thus, for ex-

ample, a tariff that generates interregional trade may improve welfare in the other region (Proposition 3.8). Domestic taxes cannot duplicate tariffs if there is cross-hauling, and taxes and tariffs have different effects on the volume of trade and on welfare (Propositions 3.9 and 3.10).

We now turn to the question of the effect of trade and price changes on real and relative factor rewards, and it is here that the increasing returns model varies most significantly from the model where constant returns to scale are assumed. There are two principal sources of difference. First, in models such as the one being described here where regions specialize, relative factor prices will be determined by the production function of the commodity produced and, for given factor supplies, will be independent of commodity prices. Second, even in situations where both commodities are produced in both regions - the case to be considered in the next section - real and relative factor prices will generally not be equalized by trade.

For the situation of Figure 5.1, if we assume that the two regions are specialized in different goods, then, as is shown in Appendix C, Section 1, trade results in diverging factor prices rather than in factor-price equalization. Indeed, specialization in different commodities will result in the largest possible difference between the factor prices of the two regions. Thus we have the following proposition.

*Proposition 5.6* With increasing returns to scale in both industries, trade that results in specialization in different commodities will result in substantial differences in relative factor prices.

These factor-price differences will generate interregional factor movements, and a number of quite different outcomes are possible. For example, it is possible that even with the two regions producing different goods and relative factor prices differing, one region may nevertheless have higher real factor rewards for both factors. This outcome is possible, for example, if one region is particularly large relative to the other, and if increasing returns are strong in the industry produced by the large region. In this case both factors will move to the large region and the small region will become depopulated and will cease to exist as an economic entity. This outcome, of course, assumes perfect factor mobility, and if all factors are not willing (or able) to move then the small

region will, in the final equilibrium, retain some factors and therefore some output capacity. All remaining factors would receive lower returns relative to factors in the large region, however. Furthermore, the differences in factor returns will increase as factors migrate, since factor returns are a function of the level of regional output. This is shown in the introduction to Appendix C. Thus we have the following proposition.

*Proposition 5.7* Even if trade results in specialization in different commodities, the large region may have higher returns for both factors. The resulting factor flows will exacerbate the factor-price differences, leaving all factors in the large region better off and all factors in the small region worse off.

If regions are more or less the same size then it is possible that the relative factor-price differences in the two regions will also be reflected in real factor-price differences. Factors will move to the region where the return is highest, and if all marginal products are negatively related to factor increases (and in general they need not be) then an equilibrium will be reached where both regions continue to specialize in different commodities. In this case it can be shown that both regions will benefit from the factor mobility and we have the interesting result that factor movements and trade are complements rather than substitutes, in contrast to the situation for the endowment model with constant returns to scale described in Chapter 3 (see Melvin 1969 and Appendix C). It is interesting to note that in this case factor movements unambiguously increase welfare. Thus we have the following proposition.

*Proposition 5.8* With specialization in different goods and with two regions of approximately the same size, factor flows may equalize real and relative factor rewards, and may result in welfare gains for both regions.

As was noted earlier, it is possible that both regions could produce and export the same commodity. In such a circumstance, unless both regions are exactly the same size, even though relative factor prices will be identical real factor prices will be higher in the large region for both factors and in this case both factors will migrate to the large region. With perfect factor mobility this mobility

will continue until the small region has been depopulated. Whatever degree of factor mobility exists, both factors in the large region will receive higher returns than in the smaller region, and the disparity will increase as more factors move. We therefore have the following proposition.

*Proposition 5.9* If with increasing returns to scale and trade both regions specialize in the same commodity, both factors will move to the larger region and both factors in the larger region will receive higher real returns.

These last three propositions illustrate one of the difficulties with models that assume increasing returns to scale. Results are seldom general, and depend crucially on such things as the relative size of regions. Note, for example, that Propositions 5.6 and 5.7 have strikingly different implications for the small region. Which result will prevail is a matter of by how much the regions differ in size, given the assumed technology.

## 2. INCREASING RETURNS TO SCALE IN ONE INDUSTRY, CONSTANT RETURNS TO SCALE IN THE OTHER

Although increasing returns to scale are undoubtedly an important phenomenon in many industries it may be somewhat extreme to assume that all industries should be so characterized. It is easy to identify industries that can be properly assumed to exhibit constant returns to scale, or at least to have the characteristic that all scale economies are exhausted at relatively small output levels. Agriculture may be one such industry.

In Section 1 above it was shown that if there are strong increasing returns to scale in both industries then specialization would be the normal outcome. It is also easily shown that this result generalizes to models with more goods than two. With returns to scale sufficiently strong, if an economy is free to trade at a fixed set of prices, and assuming that factors are perfectly mobile among industries, it will always pay to specialize completely. Such complete specialization is not observed in practice, however. Even regions dominated by a single industry such as agriculture nevertheless have some representatives of the manufacturing sector. If increasing-returns and constant-returns industries are found in the same region then there will be a range of prices such that both industries can exist in a trading equilibrium. We now turn our attention to such a model.

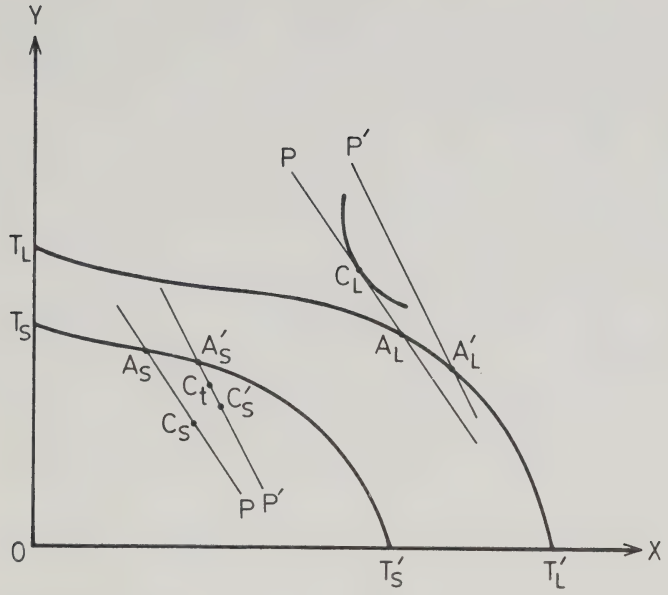


Figure 5.3

The model is the same as in Section 1 except that we now assume constant returns to scale in industry Y. We again have two regions that can trade with each other only at high cost, both of which can trade with the rest of the world at zero transportation costs. Capital and labour are assumed to exist in the two regions in the same proportions, but one region is assumed to be larger than the other. The two regions will be identified as S and L for small and large.

For this model the production possibility curves could take on a variety of shapes (see Markusen and Melvin 1981), but if we assume that returns to scale in the X industry are not too great then the production sets for the two regions will be as shown in Figure 5.3. Because one industry exhibits increasing returns and the other constant returns the commodity price line will not be tangent to the production possibility curve but will intersect it at points $A_S$ and $A_L$. Note that the relative price of X is steeper than the rate at which one commodity can be transformed into the other through production - that is, the price line is steeper than the slope of the production possibility curve.

Figure 5.3 shows the situation where, with world prices P, the small region exports commodity Y while the large

region exports commodity X. We thus again have the cross-hauling result, and the economy as a whole is observed to be importing and exporting both commodities. As before, this result is by no means guaranteed. The pattern of trade depends on the production functions, on the endowments of the two regions, and on the given world prices. Note in particular that even with the technology and factor endowments implied by Figure 5.3, there exist world prices at which both regions would export X and world prices at which both regions would export Y. Canadian regions do have different exports, however, so that the situation of Figure 5.3 would seem to be a reasonable assumption to make about the Canadian economy.

Now consider a terms-of-trade change, and in particular suppose the relative price of X increases to P'. This will increase production of commodity X in both regions and will give production points $A'_S$ and $A'_L$ as shown in Figure 5.3. Of particular interest is the fact that this increase in the relative price of X will result in a welfare improvement for both regions. Similarly a reduction in the relative world price of commodity X would reduce the production of X in both regions and result in a welfare loss for both. This is in sharp contrast to the results of Chapters 3 and 4 where, when the trade patterns of regions differ, a change in the terms of trade changes welfare in the two regions in opposite directions.

The result that an increase in the relative price of commodity X, what would be regarded as a deterioration in the terms of trade for region S, nevertheless leads to a welfare improvement stems from the fact that trade was not optimal for region S in the first place. For region S autarky is preferred to free trade and thus any terms-of-trade change that moves the region back towards autarky will be welfare-improving. More generally it can be shown that for either region an increase in the output of commodity X, the industry with increasing returns to scale, is sufficient for welfare improvement (see Markusen and Melvin 1981). We thus have the following proposition.

*Proposition 5.10* With increasing returns to scale in the X industry, and even if the two regions export different goods, a relative increase in the price of X resulting in larger output in commodity X will improve the welfare for both regions. Similarly, price changes that result in a reduction in the production of X will reduce welfare in both regions.

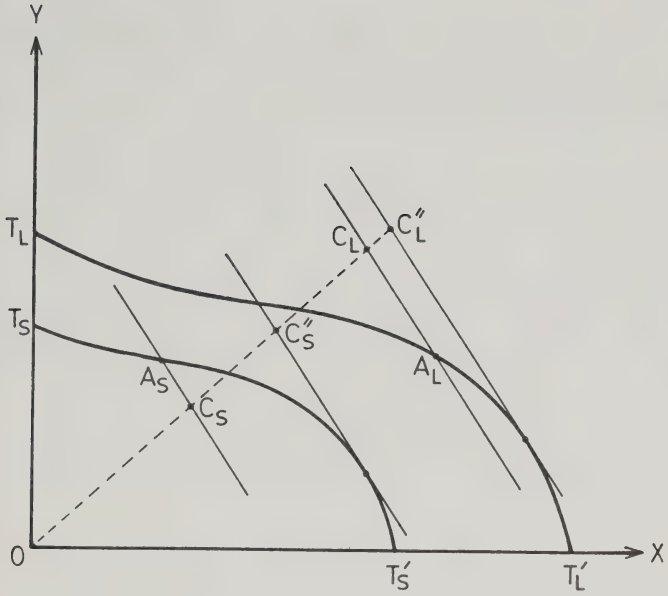


Figure 5.4

## 3. THE EFFECTS OF TAXES AND TARIFFS

Proposition 5.10 is a result of the fact that, with increasing returns in only one industry, free trade is never optimal for a small region or a small country. This is a consequence of the theory of the second best. Increasing returns to scale in the X industry act as a distortion, giving rise to an equilibrium in which the ratio of commodity prices is not equal to the rate of product transformation. The introduction of an offsetting distortion could therefore unambiguously improve welfare for both regions. In the model of Figure 5.3 the appropriate policy would be the imposition of a production subsidy on the output of industry X equal in size to the wedge that exists between prices and the marginal rate of transformation. The optimal policy is illustrated in Figure 5.4, where an appropriate production subsidy has moved production to the point of tangency between the price line and the production possibility curve. The consumption points in the two regions will be $C''_S$ and $C''_L$. Thus we have the following proposition.

*Proposition 5.11* With increasing returns in one industry, free trade is never optimal for a small region or country. Welfare will be maximized by an appropriate subsidy to the increasing returns industry (or an equivalent tax on the constant returns industry).

Two additional conclusions can be drawn from Figure 5.4. The first, and one that is always true, is that the small region has more to gain by the appropriate tax or subsidy than the large region. This is a consequence of the fact that trade was harmful to the small region in the first instance, so that moving to the first-best situation implies a larger gain. A second characteristic of Figure 5.4 is that a subsidy has reversed the pattern of trade for the small region, for after the appropriate tax both regions are exporting commodity X. That such trade reversal is not necessarily the case can be seen by making tastes much more biased towards commodity X. We thus have the following propositions.

*Proposition 5.12* With increasing returns in one industry, small regions will gain more from optimal tax policy than will large regions.

*Proposition 5.13* Optimal tax policy may reverse the pattern of trade for the small region.

It is of interest to note that while we are concerned here with international trade, the optimum policy requires a purely domestic tool and not an international one. As will be seen below, while a tariff can increase welfare for the small region, tariffs will always be dominated by a production tax or subsidy, a result of the fact that the distortion is on the production side.

Given that a price increase for commodity X will increase the welfare of a region regardless of whether it is an importer or an exporter of that commodity, it is perhaps not surprising that a tariff may also improve welfare. With initial prices P a tariff on Y would have the traditional effects for region B and would reduce welfare. Region S would be unaffected by a tariff on Y. A tariff on commodity X, however, could increase the welfare of region S. Thus, in Figure 5.3 a tariff would move the small region from $C_S$ to $C_t$, compared to the movement from $C_S$ to $C_S'$ associated with

an equal-rate production subsidy. Thus we have the following proposition.

*Proposition 5.14* A tariff will have the traditional welfare consequences for the large region. A tariff on the imports of the small region, however, may increase welfare if it increases the output of the increasing-returns-to-scale commodity.

The explanation of this result is straightforward. It has already been shown that, for a region, a tariff on X is equivalent to a production subsidy for X and a consumption tax on X. Thus part of the effect of a tariff is exactly equivalent to the effect of a production subsidy and this will tend to increase welfare for region S. The consumption distortion component of a tariff will, of course, tend to reduce welfare, and whether a tariff results in a net gain or net loss to the region will depend on which of these two offsetting effects dominates.

Consumption at point $C_t$ in Figure 5.3 assumes that all of the tariff revenue is distributed to residents of region S. If all consumers in the economy receive a share of the tariff revenue then the welfare of residents of S will be reduced, but they may still be better off than in the free-trade situation. Thus we have the following proposition.

*Proposition 5.15* A tariff on the imports of the constant-returns-to-scale commodity in the small region may increase the welfare of consumers in both regions.

But while consumers in both regions may benefit from a tariff on the imports of X in region S, they could not agree on the level of tariff to be imposed. The welfare of consumers in S is a monotonically increasing function of the tariff, and indeed the optimum tariff from the point of view of S is the tariff that eliminates all trade. For L, however, such a tariff results in no welfare gain relative to free trade, for with no trade there will be no tariff revenue. From the point of view of L the optimum tariff is the one that maximizes tariff revenue.

It is possible that a small region will benefit from a non-prohibitive tariff even if it receives *none* of the tariff revenue. This situation would be true in Figure 5.3, for example, as long as the tariff-ridden price line through

$A'_S$ (not shown) passes above point $C_S$. This is an important result, for it shows that while a tariff that generates interregional trade will reduce welfare for the economy relative to the situation with a tariff and international trade, the small region may prefer this interregional trade to free trade. Thus we have the following proposition.

*Proposition 5.16* While a tariff that generates interregional trade will reduce welfare for the economy, the small region may still be better off than with free trade.

But while interregional trade with B may be a better option than international free trade, a preferred option to either is no trade with anyone. Thus, just as it is welfare-improving to restrict international trade, so will it be welfare-improving to restrict interregional trade. Thus optimal policy for S will be a set of international and interregional trade restrictions, and we have the following proposition.

*Proposition 5.17* For a small region exporting the constant-returns-to-scale commodity, welfare will be increased by restrictions on both international and interregional trade.

In Canada in recent years there has been much concern with the level of interprovincial trade barriers. We have again found theoretical grounds for suggesting that, at least for small regions, interregional barriers may be too low.

In our discussion of interregional trade it has been assumed that the required imports of one region could be satisfied entirely by the exports of the other region. In general, this assumption is unlikely to hold, and indeed will be true only if exports and imports of the two regions are opposite and exactly equal. In Chapter 3 it was shown that if the excess supply in one region is not sufficient to satisfy the excess demands of the other then there will be a change in the terms of trade that will, in general, be beneficial to the region that exports the commodity whose price has risen. This result need not hold in the present model. Suppose, for example, that in the situation of Figure 5.3 a tariff on Y has resulted in region B importing commodity Y

from region S. Further suppose that the excess supply of Y in region S is insufficient to satisfy the import demand by region B. The price of Y in region S will then be bid up, but this increase in the price of Y will be harmful for region S rather than beneficial, for it will generate a further reduction in the output of X, the commodity produced with increasing returns to scale.

This result will not occur for the large region. If interregional trade increases the relative price of commodity X in region B then welfare in region B will be unambiguously increased. Recall again that an increase in the output of the increasing-returns-to-scale commodity is sufficient for gains. We thus have the following proposition.

*Proposition 5.18* If the small region is exporting the constant-returns-to-scale commodity, an improvement in the terms of trade generated by interregional trade will reduce welfare.

It is significant that the welfare consequences of terms-of-trade changes generated by interregional trade are opposite for the two regions. Tariffs that are sufficiently high to internalize trade in a regional economy will, in this model, have beneficial terms-of-trade effects for the large region but harmful terms-of-trade effects for the small region. Of course, the total effect must also include the cost associated with the lost revenue from the initial switch to interregional trade. The net effect may be positive for a large region but will certainly be negative for a small region that exports the commodity produced with constant-returns-to-scale technology. Large regions have a clear advantage when technology is characterized by increasing returns to scale.

It has already been shown that the optimal policy for either region is a subsidy for the industry with increasing returns to scale or alternatively a tax on the industry with constant returns to scale. Thus production taxes have strikingly different consequences in this model than they do in the world of Chapter 3 where constant returns to scale were assumed. Of course, it is not true that *any* tax on commodity Y will increase welfare, for a sufficiently large tax may overshoot the optimum production point, resulting in subsequent welfare losses. It is of interest to note that the same tax on commodity Y will maximize welfare in both

the large and the small regions. It is also true that any tax on commodity X will reduce welfare in both regions, and this will be true regardless of the level of the tax.

## 4. FACTOR PRICES AND FACTOR MOVEMENTS

We have seen that when the two regions trade at the same set of commodity prices the large region will produce relatively more of the increasing-returns-to-scale commodity. This result is evident from Figures 5.3 and 5.4. Because production functions are homogeneous and identical in the two regions, and given our assumption that both regions are endowed with factors in the same proportions, it is easily shown that the region that produces proportionately more of the commodity produced with increasing returns to scale (commodity X) will have a relatively higher wage-rental ratio (see Appendix C, Section 2). In the X industry real factor returns depend positively on the level of output, and thus since region B produces more of commodity X it is clear that the real return to labour will, at the free-trade equilibrium, be higher in region B than in region S. The real return to capital may also be lower in the large region. In any case these real and relative factor-price differences will result in factor movements, and in particular we would expect labour to move to the large region and capital to move to the small region. The movement of both capital and labour will result in a larger output of commodity X in region B and a smaller output of X in region S, and as it has already been shown, such output changes will result in welfare gains for the large region and welfare losses for the small one. We therefore have the following proposition.

*Proposition 5.19* At a free-trade equilibrium the large region will produce relatively more of the commodity produced with increasing returns to scale, and the real and relative price of the factor used intensively in that industry will be higher in the large region. The factor movements that these factor-price differences generate will further increase the welfare of the large region and reduce the welfare of the small region.

Because commodity prices are determined exogenously the factor movements described above will not result in factor-price equalization between regions as long as both regions produce both commodities. Sufficient factor movements will,

of course, result in specialization in one or both regions, and thereafter factor prices will be determined by the production functions and the endowments of the region. With specialization the results become similar to those described in Section 1, which need not be repeated here. Factor prices may or may not be equalized depending on such things as the relative size of the regions and the nature of the production functions. Thus we have the following proposition.

*Proposition 5.20* With increasing returns to scale in one industry and diversification in both regions, factor mobility will not result in factor-price equalization unless specialization in one or both regions occurs. Even then factor-price equalization is not guaranteed. Factor-price differences may persist or the small region may disappear.

It is clear that even without trade factor prices in the two regions will differ, and therefore trade is in no sense to blame for the factor-price differences or for the resulting factor movements. It is interesting, however, that factor-price differences will not be as great at autarky as they are with trade so that trade does provide some impetus for factor movements. As a corollary, we note that tariffs in either of the two regions, because they would tend to move production back towards the autarky position, will generally reduce real and relative factor-price differences between regions. Of course, even prohibitive tariffs cannot remove all of the differential. These results depend on the fact that, because of increasing returns to scale in the X industry, autarky prices in the two regions will be different even though preferences and relative factor endowments have been assumed to be identical. Thus even if all international trade is prohibited by tariffs, if interregional transportation costs are relatively low, one might observe trade between regions. In general, this trade will have exactly the same consequences as will trade with the rest of the world: welfare will increase in the large region and be reduced in the small region. Thus we can conclude that even with prohibitive tariffs optimal policy for a small region may be the imposition of interprovincial barriers to trade, and we have the following proposition.

*Proposition 5.21* Even if all international trade is eliminated the two regions would be expected to have different autarky prices with the large region having the

lower price for the commodity produced with increasing returns to scale. In such circumstances interregional trade will result in welfare gains to the large region and welfare losses to the small region.

On several occasions in this and earlier chapters we have found that if tariffs are high enough to generate interregional trade, then the optimal policy for a region or for the economy as a whole may be to institute interregional trade barriers. Proposition 5.21 is of interest for it shows that even without the distortion of tariffs interregional barriers to trade may be appropriate policy. This result is not as different as it may appear on first sight, however. In the case of constant returns to scale an interregional trade barrier can be optimal if it offsets the distortion resulting from the tariff. As has been pointed out before, this is an application of the theory of the second best. In the present circumstance the initial distortion is not policy-induced but is a consequence of the fact that there are increasing returns to scale in one of the sectors. Again the second-best policy (or perhaps first-best policy) is to introduce an offsetting distortion, in this case interregional trade barriers.

## 5. SUMMARY AND CONCLUSIONS

Models with increasing returns to scale present analytical difficulties because of the wide variety that are possible. Models with internal economies of scale yield quite different results than models in which it is assumed that the economies are external to the firm. The analysis here has concentrated on external economies partly because it allows the use of tools developed in earlier chapters, but also because it provides somewhat more precise results and allows for some policy conclusions. A full general-equilibrium analysis in which internal economies are considered is a relatively new branch of the literature, and while interesting results have been derived, the full implications of the model have not yet been worked out. This does not mean, of course, that internal economies are less important or are a less appropriate description of the economy. They have been omitted here simply because the analysis is not sufficiently general to be of much assistance in our discussion of regional economic issues. For example, the internal economy models have not yet dealt satisfactorily with the effects of

tariffs, or with the relationship between domestic taxes and tariffs.

Even after settling on external economies a wide variety of models are still available for consideration. Increasing returns can be assumed in one industry or in both, increasing returns can result in production sets that are bowed-in or that have the usual shape, and because of increasing returns to scale assumptions about the size of the two regions make a fundamental difference.

Attention was initially focused on a model in which there were increasing returns to scale in both industries, and where the returns were sufficiently large to produce a uniformly bowed-in production possibility curve. In such a model specialization in production is to be expected, and as a consequence tariffs or other policy actions will not change production. One characteristic of such models is that in general it is impossible to predict which region will specialize in which commodity.

An interesting characteristic of all increasing-returns-to-scale models is that while potential gains from trade are large there can be no guarantee that gains for a region, or for that matter for the economy as a whole, will exist. It is always possible to construct a situation where trade leads to a lower level of community welfare than would exist in autarky. This, of course, raises the possibility that tariffs or interprovincial restrictions on trade flows might be optimal policies for a region.

As in earlier chapters, it was found that tariffs that generate interregional trade will be welfare-reducing for the region and for the economy as a whole. With increasing returns to scale in both industries the losses from such interregional trade could be very substantial, and could again generate situations in which a no-trade situation would be preferred. It was also shown that because of the large volume of trade that increasing returns to scale can generate tariff revenues will be large, thus leading to the possibility that one region could be made substantially better off by tariffs applied to the imports of the other region.

A principal difference between models with increasing returns to scale and those with constant returns to scale is that, in general, the equalization of commodity prices will not result in the equalization of either real or relative factor prices. The direction of factor-price differences and the resulting factor flows were seen to depend on a variety

of factors including which commodity would be produced in each region and the relative size of the regions. In general at least one factor and sometimes both would be expected to leave the small region, leading, in turn, to further reduction in the welfare of remaining consumers.

A model in which there were increasing returns to scale in only one industry was also considered, and in this case both regions can produce both commodities in equilibrium. If the two regions export different commodities then it was shown that the small region will always export the constant-returns-to-scale commodity, and that trade will then always be harmful relative to autarky. The large region, in contrast, may enjoy substantial gains from trade. It was shown that the optimal policy for both regions would be a production subsidy to the increasing-returns-to-scale industry. Furthermore, while tariffs have the traditional effect for the large region they may increase welfare for the small region because they would generally be expected to increase the output of the commodity produced with increasing returns to scale. One result that is substantially different from those derived in the previous analysis is that although tariffs that generate interregional trade may be welfare-reducing for the economy as a whole they may be preferable to free trade for the small region.

As was the case for the model of section 1 it was found that factor prices will generally differ between the two regions whether there is international trade or not. The factor flows generated by such factor-price differences would generally increase welfare in the large region and reduce it in the small region. Tariffs will generally result in smaller factor-price differentials than will free trade.

# 6

# Policy implications

Throughout Chapters 3 to 5 we have carefully identified as propositions the conclusions that could be drawn from the analysis. A summary of the conclusions of the study can therefore be obtained by referring to these propositions, and it seems unnecessary to provide a further summary here. In this concluding chapter we will attempt to pull together the major conclusions from the three chapters in the hope that they will cast some light on current policy issues faced by the province of Ontario. Our comments will be organized around two main themes: the consequences for Canadian regional policy and particularly for regional transfers of the recognition of the regional nature of the economy, and the implications of free trade for the Ontario economy in terms of this regional model.

Before proceeding, however, it is worth while re-emphasizing the limitations of the analysis that has been presented. We have employed a theoretical general-equilibrium model which is starkly unrealistic in its assumptions, and which therefore makes no pretense to being an accurate description of the real world. It is nevertheless our hope that, simplistic though our analysis may be, it will provide important insights into some of the broad policy issues faced both by Canada and by the province of Ontario.

## 1. IMPLICATIONS FOR REGIONAL POLICY

That there are per capita income differences among the various regions in Canada has long been recognized, and the Canadian government has undertaken a variety of policy actions in an attempt to equalize income and opportunity

among regions.[1] By far the most extensive program has been the equalization payments system by which the more well-to-do 'have' provinces contribute to an equalization fund from which transfers are made to the poor or 'have not' provinces. The province of Ontario has always been a substantial contributor to this equalization fund, and it is clearly in Ontario's interest to make sure that the relatively large sums contributed are justified. It should be emphasized that our purpose here is neither to criticize the mechanism by which the equalization formula collects and distributes funds nor to discuss the basic need for such an equalization scheme. Rather our purpose is to raise some questions about the appropriate method of identifying regional disparities and to suggest that a more careful analysis of such regional differences be undertaken.

In Chapter 3 it was shown that if regions export different commodities any exogenous change in the relative price of traded goods will affect regions differently. As an example suppose that Ontario exports manufactured goods that are relatively capital-intensive and that the Atlantic provinces produce food products that use labour and land more intensively. If, over time, there is a relative increase in the price of manufactured goods then per capita incomes in Ontario will rise relative to per capita incomes in the Atlantic provinces. It is quite possible that such a trend could be seen as a justification for equalization payments from Ontario to the Atlantic provinces. But, as we have seen, even in a free-trade world these per capita income differences are not a reflection of the fact that comparable individuals in Ontario and the Atlantic region are being treated differently by the market, but rather of the fact that the change in the relative commodity prices is producing a change in relative factor prices. In particular, capital owners are made better off because the commodities in which capital is used intensively have increased in price while landowners and labourers are made worse off because of the relative reduction in the price of food products. Average incomes in Ontario will rise relative to those in the Atlantic provinces simply because Ontario has relatively more capital owners.

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1 For a summary of regional differences and the various government policies pursued to correct such distortions see Savoie (1986).

It seems clear that if per capita income differences among provinces are a consequence simply of the proportions in which factors of production exist among regions then equalization payments from one region to another are not an appropriate policy response. If in these circumstances there is a problem at all it is a problem of relative factor rewards - specifically that labour and landowners have suffered relative to capital owners. Should this be seen as a problem then the appropriate policy should be the taxation of capital and the subsidization of labour and landowners regardless of location. Of course, this will have the effect of raising per capita income in the Atlantic provinces and reducing it in Ontario, this simply being the reverse process of the one described above. Such transfers among income earners will not discriminate among factors of production on the basis of location as would be the case with interregional equalization payments. Note that if an interregional transfer from Ontario to the Atlantic region is financed through tax collection then such a transfer will leave all individuals in the Atlantic provinces better off than their counterparts in Ontario. Surely this is not the desired result of an equalization scheme.

It must be borne in mind that the argument that transfers may be inappropriate applies only if the perceived interregional differences in per capita income are due to changes in the terms of trade. We are not suggesting that all interregional transfers or equalization payments are inappropriate. Much of the justification for equalization payments, for example, stems from the desire to have all regions receive some minimal level of public services. This desire is motivated by considerations of equity and such policies have political rather than economic justification. The criticisms we have made here apply only to the economically motivated arguments for transfers.

While the long-run implications of changes in the terms of trade are clear and the appropriate policy actions straightforward, the situation is complicated somewhat when the short run is considered. In Chapter 3 it was shown that if capital is immobile in the short run then the region that is disadvantaged by the change in the terms of trade will incur larger losses in the short run than in the long run. Furthermore, the losing factor will be disadvantaged relative to that same factor in the gaining region. Whether such short-run differences should be the subject of policy action by the federal government is a normative issue about which

the present analysis has little to say. Certainly some intertemporal assistance could easily be justified.

For the model with increasing returns to scale discussed in Chapter 5 the analysis is complicated by the fact that even in a free-trade equilibrium one would not expect factor rewards to be the same among regions. Indeed, there is a presumption that some, and perhaps all, factors will receive higher rewards in large provinces such as Ontario than in less populous regions. Do factor-price differentials associated with increasing returns to scale and population size justify equalization payments? This is again a political question that cannot be answered by the positive analysis presented here, for it depends on social goals. A point to be emphasized is that if equalization payments are made on such grounds it is important that the reasons for the regional differences in income be understood.

Note also that mobile factors in the less populous regions can receive the higher rewards paid in Ontario simply by migrating. Indeed, with increasing returns to scale, all consumers in the economy could be made better off by such migration. In such circumstances interregional equalization payments could well act to inhibit adjustment to an equilibrium in which all consumers in the economy could receive higher per capita incomes. However, such migration could fundamentally change the population structure of the provinces, and could even result in the depopulation of some regions. Whether this is desirable is clearly a social or political issue.

In an increasing-returns-to-scale model we found that, if both regions produce both goods, terms-of-trade changes will have the same relative effect on factor prices as they have in the constant-returns-to-scale case. Thus a relative increase in the price of manufacturing goods will result in a relative increase in the return to the factor used intensively in the production of manufactures, and this result will be true regardless of where these factors are located. If one region has more such factors then that region will have relatively higher per capita income. Thus the basic proposition that changes in the terms of trade will have differential effects on regions if relative factor endowments differ holds for all three of the models considered. In all cases relative per capita income changes were found to be a consequence of the unequal distribution of factors of production and therefore not a problem appropriately dealt with through interregional transfers.

The point we wish to emphasize is that regional per capita income differences may not always be what they seem. In the example presented above, they were a consequence of the unequal distribution of capital and labour. There are, of course, other related differences in factor supplies which our simple model cannot incorporate but which could also give rise to per capita income differentials. Our model assumes a homogeneous labour supply, while in practice there are many different types of labour with different skills, possessing different levels of human capital, and receiving a wide range of returns. It is also clear that these different classes of labour are not proportionately distributed among regions. Thus even for a single factor such as labour one might find wide variations in average wage rates among regions associated simply with the unequal distribution of skills and professions among regions. It is generally assumed, for example, that large cities attract the most sophisticated industries, many of which require a very highly skilled labour force. One would therefore not be surprised to find that the average wage in large cities is higher than it is in small cities, this being simply a function of the composition of the work force. And, of course, if some regions have more large cities than others then per capita incomes for the regions would also reflect such unequal distribution of skills and professions. Again such differences in per capita incomes among regions are not appropriately dealt with through interregional income transfers. If in such circumstances a problem is seen to exist it must be associated with wage differentials among skilled classes or professions, and such a problem should be dealt with directly by subsidizing or taxing the appropriate individuals regardless of their regional location.

To what extent are the observed per capita income differences among regions simply a consequence of the different distribution of factors of production and the different distribution of skills and professions within the labour force? Do workers in different regions with the same skills living in cities of approximately the same population receive different real incomes? The discussion here has certainly not meant to suggest that there are no regional wage differences other than those associated with relative factor endowments. What does seem clear is that we do not know whether observed per capita income differences are simply an index number problem or whether they represent genuinely different treatment of similar individuals. It is difficult to imagine how

sensible policy to correct regional differences can be formulated unless the answer to this fundamental question is known.[2]

To this point our discussion of regional policy has implicitly assumed free trade, and we now turn to a consideration of the appropriate policy when tariffs exist. As was shown in Chapter 3 the long-run effect of a tariff is to increase the relative return of the scarce factor. Note that this is true for any tariff structure including tariffs on both commodities, assuming only that the two regions export different commodities. If we assume that Ontario is relatively well endowed with capital compared to other regions in Canada then the effect of a tariff either on the goods imported by Ontario or on the goods imported by other regions will be to increase the wage-rental ratio in Ontario relative to other provinces. Tariffs can therefore be a cause of interregional differences in wage rates and per capita incomes.

There are several consequences of these interregional factor-price differences. If factors are mobile, labour will tend to migrate to Ontario and capital will leave. If labour tends to be relatively immobile, then the principal effect will be an outflow of capital from Ontario. Recall also from Chapter 3 that these factor movements will not bring relative factor prices into equality unless the factor flows are sufficient to remove interregional differences in endowments. With tariffs, factor-price differences will exist as long as the regions continue to export different commodities.

The persistence of the factor-price differences associated with tariffs has another important implication for Ontario. We have seen that any tariff structure will reduce the wage rate in labour-abundant areas, and this relative wage-rate reduction will, quite appropriately, be seen as a regional disparity. If this regional disparity is addressed through regional equalization payments then taxes will be collected in Ontario to be transferred to those regions that are relatively labour-abundant. Of course, such equalization payments will further impede the outflow of labour from such regions and will thus tend to exacerbate the interregional disparities. It is also important to note that these interregional transfers will be required year after year, and as

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2 For a more complete discussion of these issues see Melvin (1987).

a consequence will be a continuing burden on the Ontario taxpayer. Tariff removal would eliminate this component of interregional factor-price differences once and for all.

When the short run is considered, the situation becomes more complex, for short-run factor-price changes need not be the same as the long-run changes. While the effects of a tariff on the returns to labour are uncertain there is a presumption that labour will be made worse off by a tariff. Thus the short-run effects of a tariff on the commodities Ontario imports will be to reduce the relative return to labour while the long-run effect will be to increase labour's return. The short-run signal given to labour to leave Ontario is clearly inappropriate in terms of the long run, and certainly policies designed to increase short-run factor mobility will not be appropriate. Faced with this dilemma between the short-run and the long-run implications of tariffs it will be extremely difficult to formulate acceptable and consistent policies on factor flows and interregional transfers.

There are several other implications for policies concerning the regional distribution of national product that can be derived from the analysis of Chapters 3, 4, and 5. It was shown that a region can gain from a tariff imposed on the imports of other regions, and thus Ontario could gain if it persuades the federal government to levy tariffs on the imports of the West and the Atlantic provinces. There are two sources of gains: the gain associated with the distribution of tariff revenues and the gain associated with a possible improvement in the terms of trade associated with interregional trade. Both of these gains were initially identified in the constant-returns-to-scale model of Chapter 3, but both were also found in the analysis of Chapters 4 and 5. Indeed the gains both from tariff revenue and from improvement in the terms of trade are larger in the short run than in the long run. It was also found that the potential gains with increasing returns to scale are substantially larger than for constant returns to scale.

Two points concerning these potential gains must be made. First, if Ontario were to gain from such policies it would be entirely a transfer from other regions since the economy as a whole will generally be worse off with tariffs. The gains associated with tariff revenue depend on how the federal government disposes of such revenue, and are unlikely to be important. Gains associated with an induced change in Ontario's terms of trade through the imposition of

tariffs on the imports of other regions could, however, be important. In this case in particular, the loss to the economy as a whole will be large, for the induced change in production in Ontario is inappropriate from the point of view of both world and economy-wide efficiency. Thus the economy will lose through the initial imposition of the tariff, will lose further from the distortion in production associated with the change in the terms of trade in Ontario, and thus any gain for Ontario will be accomplished by very substantial losses for consumers elsewhere. The hardship suffered in other regions will also be exacerbated by the differences in regional populations, for the gain will be shared by many and the loss shared by few. One would hope that beggar-thy-neighbour policies of this kind would not be consciously pursued by any provincial government.

Second, there is also the possibility that the gains associated with tariffs on the imports of other regions will be outweighed by the losses associated with the higher equalization payments that Ontario would undoubtedly be required to pay. On balance, it seems unlikely that provinces have much to gain through manipulating the tariff structure that is relevant for other regions.

A final conclusion relates to the role provincial governments can play in offsetting undesirable or unpopular federal policies. It was shown that in a regional economy taxes imposed at the federal level cannot duplicate a tariff structure, for while taxes apply to all consumers tariffs do not if regions import different commodities. But while taxes at the federal level cannot duplicate a tariff structure taxes at the provincial level can. Thus a province, faced with a federal tariff that it feels is acting to its disadvantage, can pursue policy measures that will act to offset the undesirable consequences. Consumption taxes or subsidies can offset the consumption-side effects, and subsidies to industry could counterbalance the production consequences of tariffs. There may well be some scope for provincial governments to improve the economic conditions for their constituents with such policies or at least to use the threat of such policies as a bargaining device in negotiations with the federal government.

Another form of policy designed to offset undesirable federal policies would be the imposition of interprovincial barriers to trade. In Chapters 3 to 5 it was shown that tariffs could result in unnecessary interprovincial trade, which would be welfare-reducing for the economy as a whole

and certainly for the region in which the tariff is effective. In such circumstances the imposition of interprovincial barriers to trade will offset at least the loss associated with the interregional transportation costs.

This argument must not be interpreted as general support for interregional barriers to trade. Barriers to the natural flows of commodities among provinces are obviously undesirable and restrictions on interregional trade only make sense if this trade has been artificially generated through other policy actions such as tariffs.[3] Of course, determining which type of interregional trade barriers are desirable and which undesirable will not be an easy task.

## 2. TRADE POLICY

Some of the trade policy implications for Ontario have been described in Section 1, and a lengthy discussion of these will not be undertaken. It has already been noted that tariffs that generate interregional trade result in a wasteful use of resources in the economy, and generally this will be harmful to all consumers. It was shown that tariffs will generate interregional factor-price differences and that these will generally imply an outflow of capital from Ontario. A further cost to Ontario may be the increased equalization payments that such factor-price differences imply.

Another implication of the analysis that may have significance for Ontario is that tariffs may result in different short-run and long-run trade patterns for a region and for the economy as a whole. This difference will be important if the various possible export patterns differ substantially in their requirements for transportation services. Obviously it would be inefficient to construct a transportation service designed to serve a particular export only to find that in the long run, when factors have had an opportunity to adjust both intersectorally and interregionally, this commodity becomes an import.

There are several important trade results that arise from the discussion of increasing returns to scale in Chapter 5. If increasing returns to scale are pervasive in the manufac-

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3 Again we have an example of second best where two distortions are better than one. Removing *both* distortions is the optimal policy, of course.

turing sector then one would expect trade to result in more specialization. Of course, by implication, some industries or firms will then have reduced outputs or may be eliminated, and the factors previously employed in such industries will be required to seek employment elsewhere. Such alternative opportunities will exist, however, and although there can be no denying the costs associated with such a transition, this rationalization of the production sector will almost certainly lead to long-run gains. Although such gains cannot be guaranteed there is a presumption that they will exist and they may be very large. Recent policy discussions concentrating on the fact that free trade may result in unemployment because some industries will be reduced in scale of operation and some may go out of business entirely neglect the other side of the argument, namely that other industries will be expanding and others created which will require the services of these displaced factors. Indeed much of the gain associated with trade occurs precisely because inefficient industries or firms are forced to contract or shut down. There can be no gains from production without such adjustments.

Another result from Chapter 5 with implications for Ontario is that, with increasing returns to scale in some sectors and constant returns to scale in others, free trade is never optimal for a small open economy or region. With completely unrestricted trade too little of the increasing-returns-to-scale commodity will be produced. Welfare will therefore be increased by any policy action that increases the output of the sectors producing under conditions of increasing returns to scale. Optimal policy in this case is not a tariff but rather a production subsidy.

This indicates that an industrial policy may not be as undesirable as is so often argued in the economics literature (see also Harris 1985). Indeed some form of industrial policy will by required if welfare is to be maximized in a world of increasing returns to scale. For small regions a much stronger statement can be made: unrestricted free trade may well result in welfare losses as compared to autarky, while production subsidies could produce very substantial gains.

The precise form that production subsidies should take cannot be determined from this analysis. In a many-industry world the problems of 'picking potential winners' will be substantially more complex than in our theoretical two-commodity model. Presumably some form of tax relief would be

the most efficient method of providing assistance, with the tax benefit depending on the success of the industry. It is interesting to note that at the present time the federal government imposes a significant manufacturer's sales tax, and if the manufacturing sector is characterized by increasing returns to scale, this is just the opposite policy to that suggested by our analysis.

A final important implication from Chapter 5 is that in a regional economy with increasing returns to scale the large regions will be expected to be the big winners. The effect of increasing returns to scale could very well increase the returns to both capital and labour as a result of the specialization free trade would allow. Our analysis therefore supports the results of Harris (1984a), who has shown that there will be substantial gains associated with free trade with the United States. Because these gains are associated with the rationalization of the manufacturing sector, and because most of this manufacturing sector is located in central Canada, it seems clear that the big winners from free trade will be Ontario and to a lesser extent Quebec. It is puzzling that in the present debate over the possibility of free trade the principal opponent appears to be Ontario, the province with the most to gain.

## APPENDIX A

# An endowment model of regional trade: the long run

The model used in Chapter 3 is the endowment model from international trade with two goods, X and Y, produced with two factors, K and L, under conditions of constant returns to scale. Factors are assumed to be in fixed supply. Thus we have:

(1) $X = F_X(K_X, L_X)$,

(2) $Y = F_Y(K_Y, L_Y)$,

(3) $K = K_X + K_Y$,

(4) $L = L_X + L_Y$.

Commodity Y is assumed to be capital-intensive at all relative factor prices so that $K_Y/L_Y > K_X/L_X$.

### 1. THE REGIONAL MODEL

It is assumed that the two regions, E and W, produce X and Y with production functions (1) and (2), and that the total factor supplies are divided between the two regions so that $(K/L)_E > (K/L)_W$. That is, we assume that region E is relatively well endowed with K. Both regions are small and face the same set of world commodity prices.

To illustrate how the domestic economy can be 'regionalized' it is convenient to use an extension of a technique developed by Lancaster (1957). Figure A.1 represents the factor-box diagram for the entire economy, and with commodity X assumed to be labour-intensive we have the production contract curve $O_XAO_Y$. With the economy assumed to face fixed relative prices, P, equilibrium would be at a point such as A. If from $O_X$ we draw a line with slope equal to the capital-labour ratio in industry Y, and from $O_Y$ a line with slope equal to the capital-labour ratio in industry X, we construct a parallelogram $O_XAO_YB$.

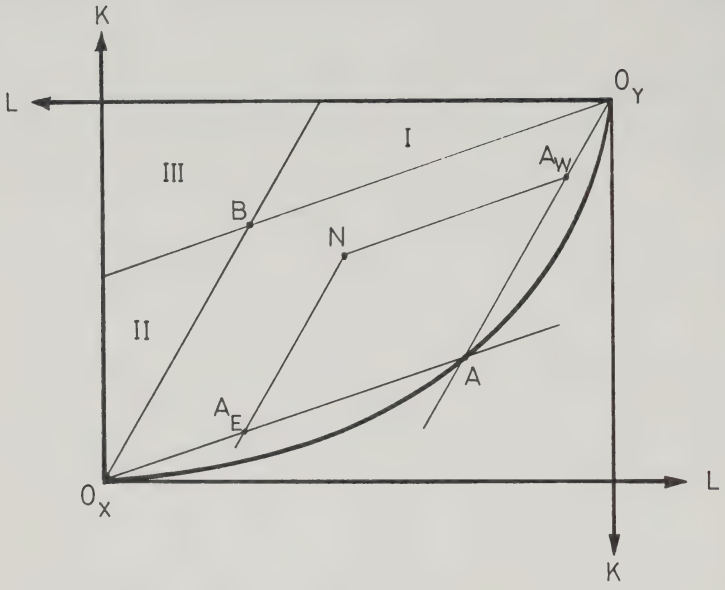


Figure A.1

The allocation of the economy's total supply of factors between the two regions can be represented by some point within the factor box. Thus point N could represent the endowment of region E measured from $O_X$ and the endowment of W measured from $O_Y$, where we have assumed that E is well endowed with capital relative to W. If point N lies within the parallelogram, then since the same production functions are available in both regions, both E and W can produce both commodities with the same relative factor prices that would have existed had all factors been available at a single location. A contract curve for region E could be drawn through $O_X A_E N$, and a similar contract curve constructed for region W. Note that equilibrium factor-price ratios at $A_E$, A, and $A_W$ must all be the same, and equilibrium commodity prices for both regions and the economy as a whole would be identical.

In Figure A.2 the production possibilities curve for the entire economy is represented as TAT' with the transformation curves for the two regions similarly labelled. With price ratio P, production points are A, $A_E$, and $A_W$, which correspond to the similar points in Figure A.1. Note that $A_E$ and $A_W$ sum to A, a fact that will be true for the production

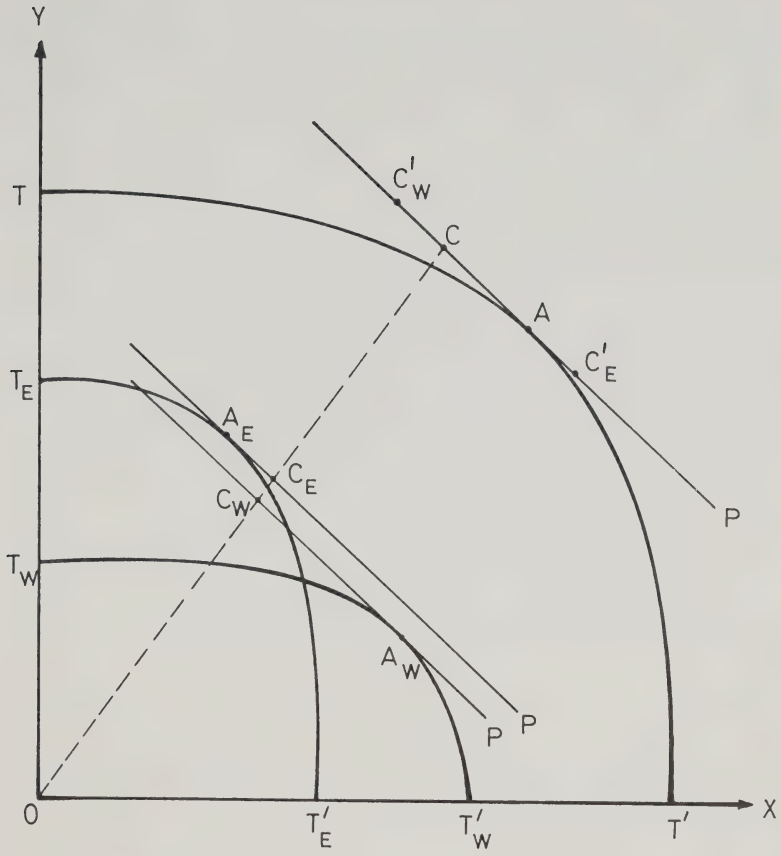


Figure A.2

points corresponding to any commodity price line. The trade vectors are $A_EC_E$ and $C_WA_W$ for regions E and W respectively, giving a trade vector for the economy as a whole of $A_EC_E + C_WA_W = C'_WC'_E$. The net trade vector for the economy is $C_WA_W - A_EC_E = CA$. It is the net trade vector CA that would be considered as the trade vector in a model where the two regions were not specifically identified.

There is, of course, no reason to expect endowment point N to lie inside the parallelogram $BO_XAO_Y$ in Figure A.1. If it lies outside the parallelogram then either or both of the two regions must specialize in one or the other of the two commodities. Specifically, in area I region W will specialize

in commodity X, in area II region E will specialize in commodity Y, and in area III E specializes in Y and W in X. Note, also, that the question of whether both goods can be produced in equilibrium in both regions, or whether one or both regions will specialize, will depend on commodity prices. For example, with endowment point N specialization by region E or region W can be generated by making the relative price of X higher or lower.

## 2. THE EFFECTS OF TARIFFS

It can be shown that the effects of a tariff are symmetrical between regions, so to simplify the analysis we will consider the case of a single tariff. In Figure A.3 (as in Figure A.2) the volume of trade for W is larger than the volume of trade for E so that the economy as a whole is a

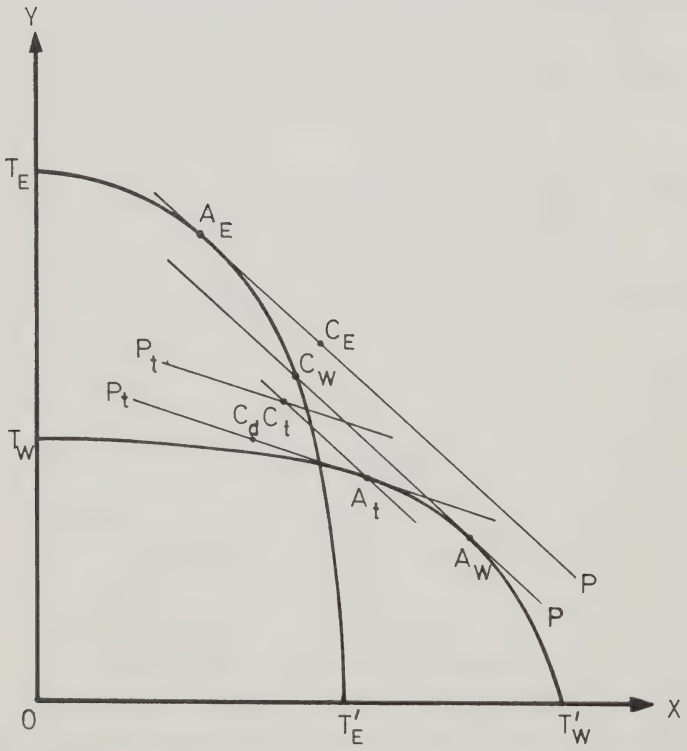


Figure A.3

net importer of Y, the import commodity in W. It therefore seems natural to consider the imposition of a tariff on Y. Such a tariff will have no effect on region E since that region exports Y. In region W the effects are the traditional ones associated with the imposition of a tariff for a small country. Production will move to $A_t$, where the price line $P_t$ is tangent to the production possibility curve, and the new consumption point will be $C_t$, where the price line $P_t$ is tangent to an indifference curve along the world terms of trade P. The tariff on Y has resulted in a significant welfare loss to region W, but has not affected E.

In Figure A.3 consumption at point $C_t$ by residents of region W can occur only if all the tariff revenue is returned to that region. If W receives none of the tariff revenue, then the gains from trading at prices P would be lost for region W, and consumption would be at $C_d$ on the line $OC_t$. The distribution of the tariff revenue between the two regions will determine where, on the line segment $C_dC_t$, the final consumption point for region W will be.

The prices faced by producers in the two regions in Figure A.3 differ, and thus production points $A_t$ and $A_E$ do not sum to a point on the economy's production possibility curve TAT' of Figure A.2. This demonstrates Proposition 3.5.

## 3. TARIFFS AND INTERREGIONAL TRADE

If, in Figure A.3, we continue to impose higher and higher tariffs on commodity Y, it is possible that at some point the tariff rate will become equal to the interregional transportation cost for Y. Suppose in Figure A.3 this has occurred at price line $P_t$. With any small additional tariff region W will find it cheaper to purchase commodity Y from region E than from ROW (Rest of the World or foreign country). Region E will be indifferent as to whether trade is with region W or with ROW as long as region W pays the entire cost of transportation. Assume that the exports of region E are sufficient to satisfy the demands for imports of commodity Y by region W. Region W now imports Y from E at the price ratio $P_t$, and because there is now no tariff revenue, the consumption point in region W will be $C_d$. Thus, associated with the switch from international to interregional trade we now have a discrete fall in consumption from $C_t$ to $C_d$.

In Figure A.3, in the initial free-trade situation, we have $C_WA_W > A_EC_E$, implying that the economy as a whole is a net exporter of commodity X. With the tariff and before

interregional trade we have $C_tA_t < A_EC_E$, so that now the economy is a net exporter of Y. Thus the tariff has reversed the pattern of trade. Note that a tariff always reduces the imports of the commodity on which it is imposed.

## 4. TARIFFS AND TERMS-OF-TRADE EFFECTS

Suppose that the exports of Y by region E are not sufficient to satisfy the import demands of region W. In this case E may actually gain from the tariff. To illustrate, assume that region E is initially self-sufficient so that only region W trades internationally. This case is shown in Figure A.4, where $C_W$ and $C_E$ are the free-trade consumption points for regions W and E, respectively. Now suppose a tariff is imposed on commodity Y which is higher than the interregional transportation cost. Region W will now want to import Y from

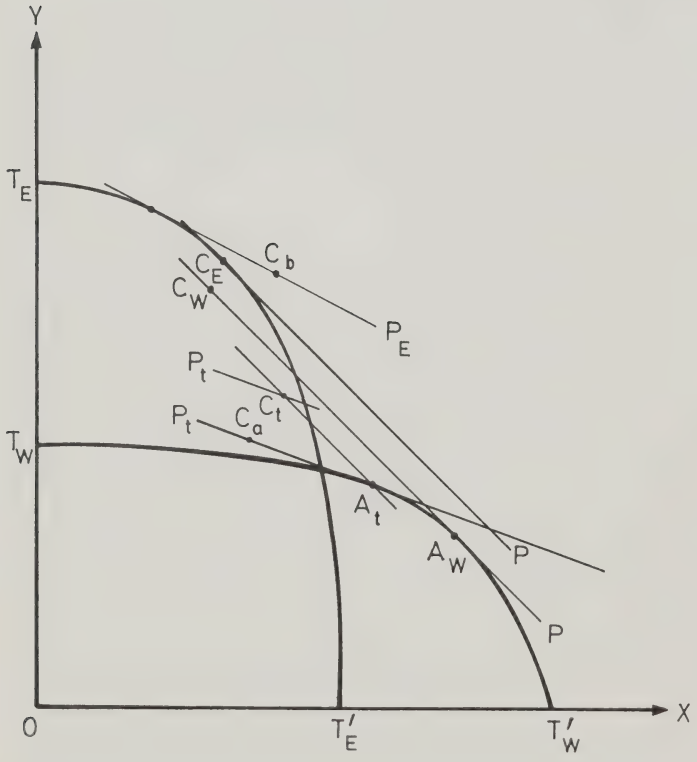


Figure A.4

region E, but can do so only by bidding up the price of Y in E, since otherwise no Y is available for export. Suppose at price $P_E$ region E is just able to provide the quantity of Y demanded by region W. Note that the difference between the slopes of $P_t$ and $P_E$ represents the transportation costs between the two regions. Equilibrium consumption points for regions W and E would be $C_a$ and $C_b$, respectively.

The consequences of a tariff in region W are similar to those described for Figure A.3. Initially the tariff moves the consumption point from $C_W$ to $C_t$ and then the internalization of trade moves consumption from $C_t$ to $C_a$. For region E, however, the situation is quite different. The tariff-generated demand for region E's output has resulted in an improvement in the regional terms of trade with consumption moving from $C_E$ to $C_b$. This result is also possible for the situation of Figure A.3 where E initially imports X, and will occur if W's interregional demands for Y are larger than E's exports of Y. Of course, this terms-of-trade gain must be set against the welfare cost associated with the loss in tariff revenues for that region, but a net gain for E is certainly possible.

## 5. TAXES AND TRADE

Figure A.5 illustrates the effects of a production tax on Y and a consumption tax on X, that apply to both regions. For region E, the production tax on Y will reduce the relative price of Y received by producers to $P_t$ and the production point will move to $A_t$. An equal-rate consumption tax on commodity X will increase the price consumers pay to $P_t$. Trade can still take place at world terms-of-trade P, so that consumption will be at $C_t$. Thus this tax system is equivalent, for region E, to a tariff on X. For region W, the taxes are equivalent to an export subsidy moving production to $A_S$ and consumption to $C_S$. While a tariff on X will only affect region E, the tax system that is equivalent to the tariff will affect both regions. There is no system of taxes applied uniformly to both regions that duplicates a tariff on X. The same argument applies for a tariff on Y.

The tax structure has been seen to be equivalent to an export subsidy for region W. Note that the welfare losses in this case can be larger than would be possible for a tariff on Y. The worst that a tariff can do is eliminate trade and move the region to the autarky position. In Figure A.5 the tax structure has resulted in consumption inside the production possibility curve, and thus autarky would be preferred.

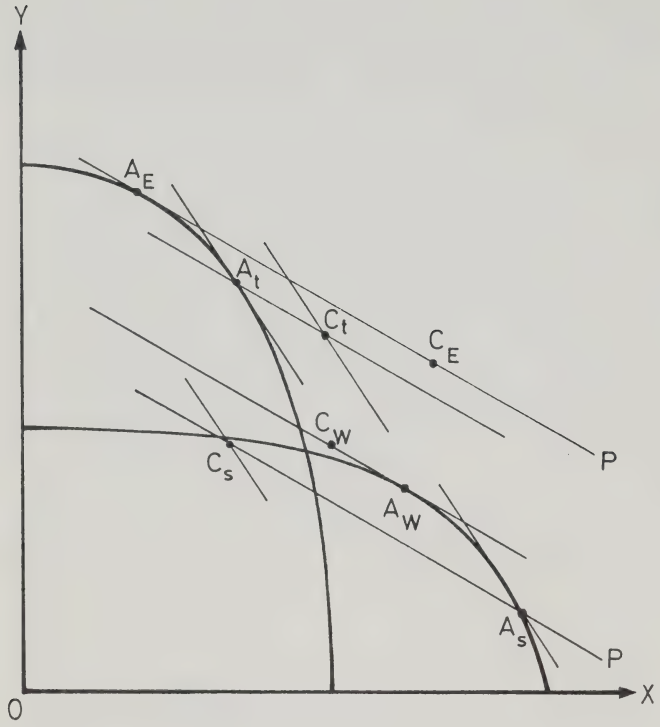


Figure A.5

The tax implications for the volume of trade are also quite different than for tariffs. A tariff will always reduce the volume of trade for the economy as a whole. The tax structure of Figure A.5 applied uniformly to both regions will reduce trade for one region and increase it for the other, and there can be no presumption as to how the overall volume of trade will change. Furthermore, note that in the tax equilibrium of Figure A.5 the economy has become a net exporter of commodity X ($C_SA_S > A_tC_t$), and thus the tax structure has reversed the trade pattern.

## 6. REGIONAL ECONOMIC POLICY

It has been shown that a change in the terms of trade facing the economy can increase the per capita income of one region and reduce it in the other. We now investigate the consequences of such terms-of-trade changes for factor incomes.

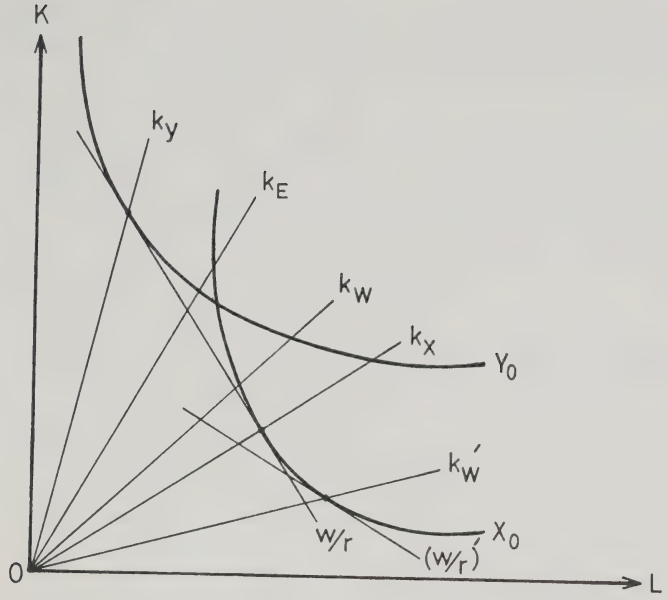


Figure A.6

An important result for such an analysis is the factor-price equalization theorem, which can be stated as follows.

*Factor-price equalization theorem* Given the assumptions of our model, if both regions produce both goods in equilibrium, then the equalization of relative commodity prices will result in the equalization of relative factor prices.

This important theorem is most easily demonstrated by using the unit-value-isoquant diagram of Figure A.6, where isoquants $X_0$ and $Y_0$ have been chosen so that the values of these levels of outputs are equal when evaluated at prevailing prices P. Thus $P_xX_0 = P_yY_0$ and $P = P_x/P_y$. Important assumptions for the theorem are constant returns to scale and identical production functions for regions. The former implies that only the scale of Figure A.6 is affected by different choices of output levels satisfying $P_xX_0 = P_yY_0$, and the latter ensures that the same diagram will be relevant for both regions.

The common tangent to $X_0$ and $Y_0$ is the equilibrium wage-rental ratio, and $k_y$ and $k_x$ are the capital-labour ratios for the two industries. Note that w/r (the wage-rental

ratio) depends on the production functions and on P but not on the factor endowments of the region, and this is the essence of the proof of the factor-price equalization theorem.

One final assumption is required, namely that both goods are produced, and this will be satisfied if the K/L ratios for both regions lie between $k_y$ and $k_x$. Thus with $k_E$ and $k_W$ the capital-labour endowment ratios for E and W, Figure A.6 corresponds to Figure A.2 and factor prices are equalized in the two regions.

Now consider a change in commodity prices that affects both regions equally. If, for example, P decreases then this implies either that $P_x$ falls, that $P_y$ rises, or both. Suppose $P_y$ increases. Then to maintain the condition $P_xX = P_yY$, Y must decrease, and the relevant isoquant will lie closer to the origin in Figure A.6. This shift implies a decrease in w/r, but the relevant point is that it will imply the *same* decrease in w/r in both regions. Thus a change in the terms of trade, while generating different per capita incomes in the two regions, does not result in different interregional factor payments.

We have shown that an increase in the price of Y (or a decrease in the price of X) results in a decrease in the relative price of labour (i.e. w/r falls). Recall that X is the labour-intensive industry. In general we find that an increase in the price of a commodity will increase the relative price of the factor used intensively in the production of that commodity. Indeed an even stronger statement is possible, for it can be shown that an increase in the price of a commodity will increase both the relative and the real return to the factor used intensively in its production, and will reduce the relative and real return of the other factor, where real returns are measured in terms of either commodity price. Thus a relative increase in the price of Y will make capital owners better off in terms of both X and Y and will make labour worse off in terms of both X and Y. This is the Stolper-Samuelson theorem.

The above arguments have assumed that both commodities continue to be produced in both countries. In terms of Figure A.6 this assumption implies that both $k_E$ and $k_W$ lie between $k_y$ and $k_x$. But now suppose region W is even more well endowed with labour so that the K/L ratio becomes $k'_W$. Now there can be no common tangent to $X_0$ and $Y_0$ consistent with $k'_W$, and thus region W specializes in X with a new wage-rental ratio equal to $(w/r)'$. Thus if one region

specializes it must have a relatively lower return for its abundant factor.

Now suppose there is interregional factor mobility. Labour will move from W to E and capital from E to W, and thus the K/L ratios in the two regions will move towards each other. They will continue to do so until either both regions again produce both goods (or at least could at the margin) or both regions specialize in X at the same $K_X/L_X$ ratio. In either case regional factor prices will again be equal.

## 7. INTERREGIONAL FACTOR MOBILITY

Consider a region facing a fixed ratio of commodity prices. If the region produces both goods, then both factor prices and the capital-labour ratios in the two industries are given. Thus in the factor-box diagram of Figure A.7 with capital stock $K_E$ and labour supply $L_E$, the capital-labour ratios for X and Y will be $k_x$ and $k_y$ respectively. A production contract curve could be drawn through $O_xAO_y$.

Now suppose there is a labour inflow and that the new labour supply is $L_E'$. With unchanged commodity prices, $k_y$ and $k_x$ will be unchanged, and the new equilibrium must be at B. $O_xB > O_xA$ implies that the output of X has risen, while $O'_yB < O'_yA$ implies that the output of Y has fallen. Thus an

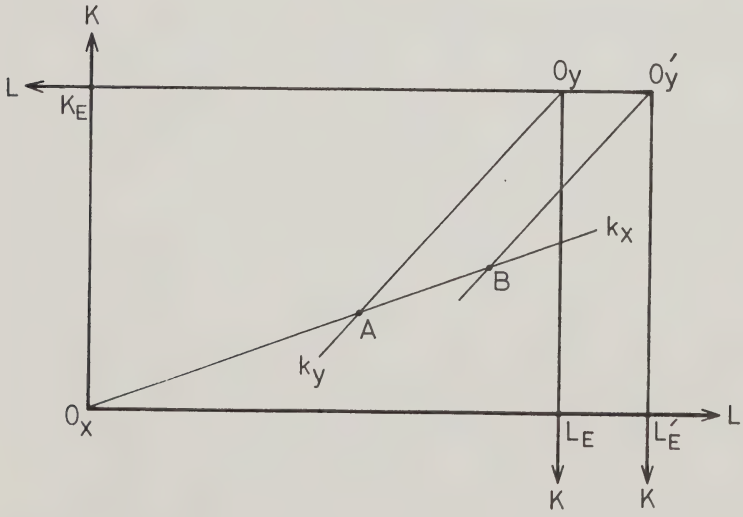


Figure A.7

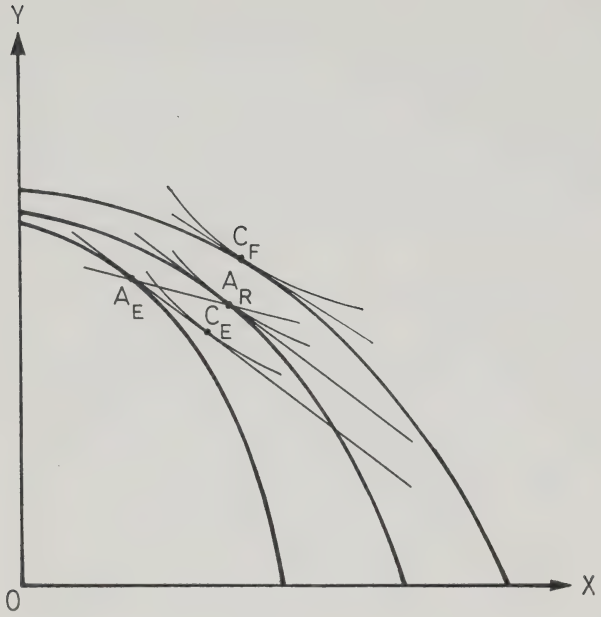


Figure A.8

increase in a factor of production will increase the output of the commodity that uses that factor intensively, and reduce the output of the other, which is the Rybczynski theorem.

It has been shown that factor movements will not change factor returns as long as commodity prices remain fixed. Sufficient factor mobility, however, could result in changes in the commodity prices in either or both regions. Figure A.8 shows the situation for region E with $A_E$ and $C_E$ the pre-factor-movement equilibrium of Figure A.3. An inflow of labour from region W will cause E to move along the Rybczynski line $A_E A_R$, and at $A_R$ all trade for region E will have been eliminated. Factor prices will still be unequal across regions, however, and thus the labour inflow will continue. Now, since trade has been eliminated, this increase in labour will result in a gradual increase in the relative price of Y as prices adjust to equate regional demands and supplies. The final equilibrium could be a point such as $C_F$. Figure A.8 assumes that the tariff and the transporta-

tion costs continue to eliminate the possibility of trade either with region W or with ROW, but this assumption need not hold.

The opposite changes are occurring in region W, where the labour outflow is causing the production possibility curve to shift inward as the economy moves along its Rybczynski line. Again, after trade has been eliminated, the price of X will begin to fall and factor flows will cease only after commodity prices have been equalized between the two regions. At this point, of course, both regions have exactly the same capital-labour ratios and they thus differ only in relative size. Both will now be scaled-down versions of the overall economy. In the final equilibrium, all the interregional distortionary effects of both the tariff and the transportation costs have been removed by factor flows, so that eventually factor mobility will eliminate the differences in regional real incomes associated with tariffs.

## APPENDIX B

# An endowment model of regional trade: the short run

The specific-factor model used in Chapter 4 assumes two commodities, X and Y, produced with two factors of production, where both production functions exhibit constant returns to scale. The production functions both use labour, which is assumed perfectly mobile between the two sectors, but each also employs a factor that is specific to that industry. These two specific factors, assumed to be different types of capital for purposes of Chapter 4, are in fixed supply and are fully employed in the industry to which they are specific. If we identify the factor specific to industries X and Y as T and R respectively then the production side of the model is characterized as follows:

(1) $X = F_X(T_X, L_X)$,

(2) $Y = F_Y(R_Y, L_Y)$,

(3) $T = T_X$,

(4) $R = R_Y$,

(5) $L = L_X + L_Y$.

While the version of this model used in Chapter 4 assumes that the two specific factors are two different types of physical capital, in general the model has a much broader interpretation. The factors R and T could refer to quite different inputs, and could, for example, be two types of natural resources, or one could be land and the other capital. Most of the results in succeeding sections of this appendix will apply equally well to the broader interpretation of the model.

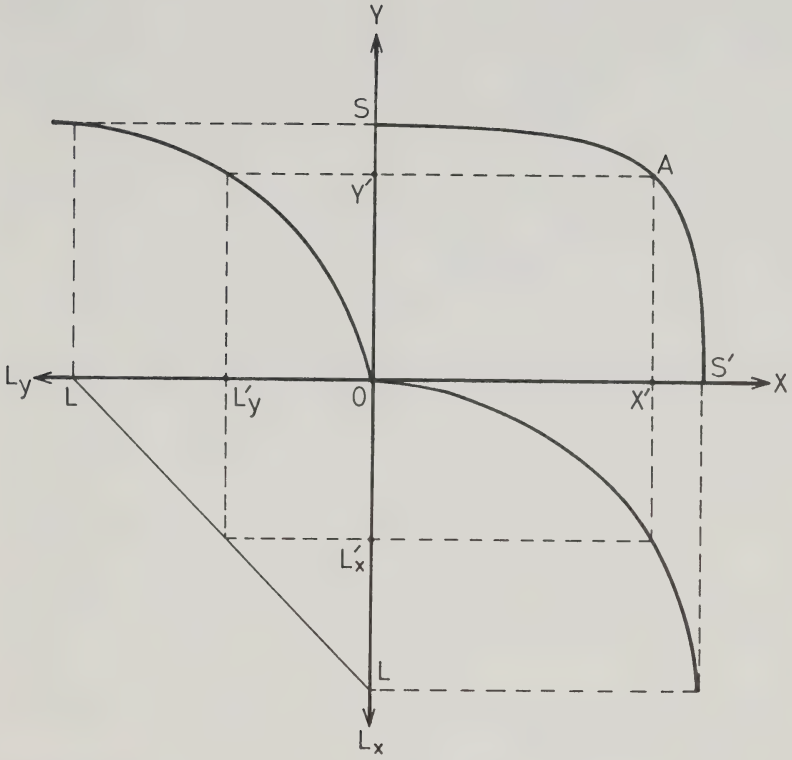


Figure B.1

## 1. DERIVATION OF THE PRODUCTION POSSIBILITY CURVE

Although the specific-factor model has three different factors, because one factor is specific to each industry the derivation of the production possibility curve is somewhat simpler than in the two-factor model described in Chapter 3 and Appendix A. The specific factor is assumed to be fully employed at all levels of output in the industry in which it is used and thus the two production functions are functions of only one variable input. Total product curves for both industries, which show the level of output for varying quantities of the variable factor labour and fixed inputs of the specific factors, can then be used in the derivation. These total product curves are shown in quadrants 2 and 4 of Figure B.1. The labour constraint is shown in the third

quadrant, where L, measured along either the $L_y$ or $L_x$ axis, represents the total available quantity of labour. If the entire labour supply is allocated to the Y industry an amount of Y shown by point S can be produced. If the entire labour supply is allocated to the X industry then S' of X can be produced. If $L'_y$ of labour is allocated to the Y industry and $L'_x$ to the X industry then Y' and X' can be produced, giving A on the short-run production possibility curve. All other points on the locus SAS' can be traced out by alternative allocations of labour between the two industries, that is by considering the outputs associated with all points along the line LL in the third quadrant.

Note that this short-run production possibility curve exhibits much more curvature than the long-run curve of Figure 3.1. The production possibility curve may even become perpendicular to the axis at its end-points S and S' (at least in the limit). It would do so, for example, if both functions were Cobb-Douglas. This increased curvature implies that if both commodities are produced at some initial equilibrium both will continue to be produced in the short run for any finite commodity price change. Thus the possibility of specialization is not a concern in this short-run model, unless specialization occurs at the initial equilibrium.

From a long-run point of view the locus SAS' can be seen as one of the infinite number of possible short-run production possibility curves, each one associated with a different allocation of the total quantity of capital between the two industries. Indeed, the long-run production possibility curve is just the envelope of all the short-run curves.

The relationship between the short-run and long-run production possibility curves can be seen more clearly from Figure B.2, which is the factor-box diagram for a representative region. The dimensions of the box give the total available amounts of capital and labour, and the long-run efficiency locus is $O_xAO_y$. All points such as A on this locus give an output of X and Y that can be plotted in output space. The locus of all such points gives the long-run production possibility curve of Figure 4.1. It is assumed that point A in Figure B.2 corresponds to A in Figure B.1 and to $A_E$ in Figure 4.1.

In the short run capital is not mobile between sectors and its allocation between the two sectors is given by the line TR. Point T measured from $O_x$ gives the amount of capital in the X industry while point R measured from $O_y$ is the

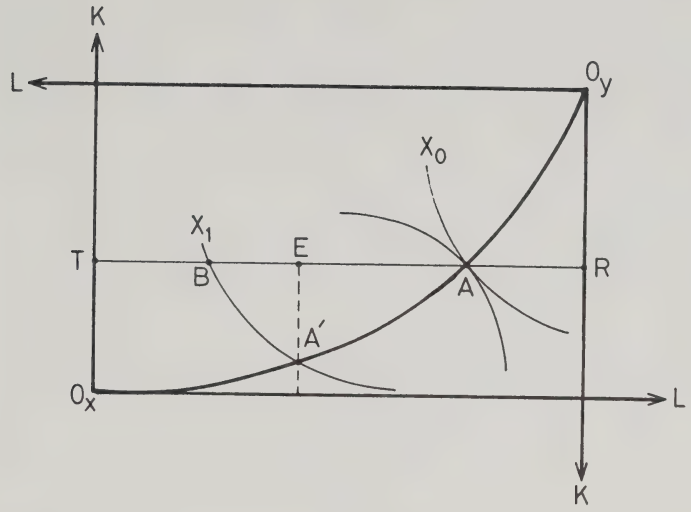


Figure B.2

amount of capital in the Y industry. The line TR can be thought of as the short-run locus corresponding to the long-run efficiency locus $O_xAO_y$.

Given that capital is immobile in the short run, it is clear that point A is the only point where the short-run and the long-run production possibility curves correspond. Now consider an increase in the relative price of Y as was analysed in Figure 4.1. This will result in an increase in the output of Y and a reduction in the output of X, and in the long run could result in production at point A' corresponding to point $A'_E$ in Figure 4.1. Note that this same output of X for the short run, that is production at point B, would imply a significantly smaller level of output of commodity Y, for the Y isoquant tangent to $X_1$ at A' represents a higher level of output than the Y isoquant through point B. This argument applies to all points along TR, and thus we see that the short-run production possibility curve must lie strictly inside the long-run curve except at point A.

## 2. THE EFFECTS OF TARIFFS

In Figure B.3 an initial long-run equilibrium is shown with production at point A and consumption at C. We now assume

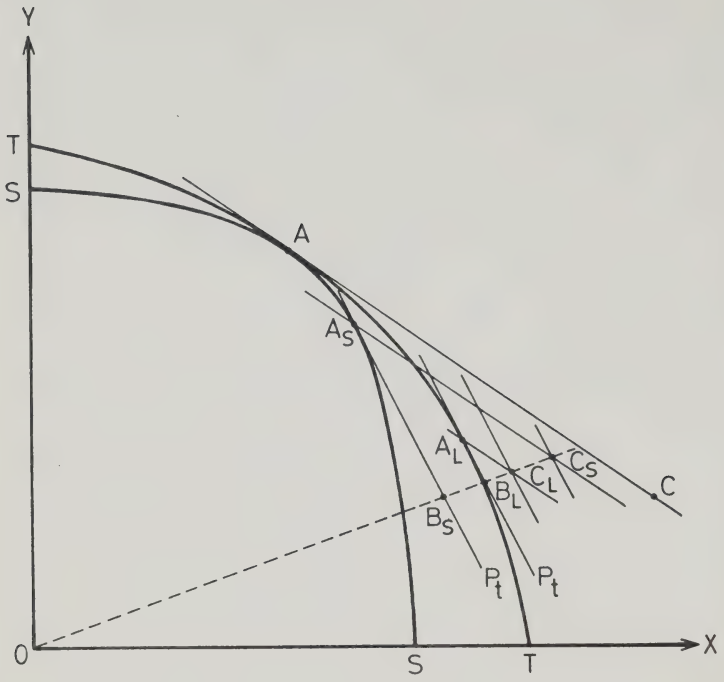


Figure B.3

that a tariff is imposed on commodity X resulting in price line $P_t$. In the long run production will move to point $A_L$ and consumption to $C_L$. In the short run production will be at $A_S$ and consumption at $C_S$. In the situation shown the short-run cost of the tariff is less than the long-run cost, in spite of the fact that the terms-of-trade effect is larger for the short run than for the long run. Thus if the economy were forced to trade at price line $P_t$ long-run consumption would be at $B_L$ and short-run consumption at $B_S$. The reason that short-run welfare is higher with trade is due to the volume-of-trade effect. In the short run the production change is much less (a move to $A_S$ as compared to $A_L$), which results in a short-run volume of trade $A_SC_S$ as compared to the long-run volume of trade $A_LC_L$.

There is, of course, no guarantee that the short-run welfare costs of the tariff will be less than the long-run costs. The long-run production point could lie above the terms-of-trade line through $A_S$, in which case the short-run welfare cost of the tariff would be larger than the long-run

effects. Note, however, that even if the production point $A_L$ is above the terms-of-trade line through $A_S$ the short-run volume of trade must still be larger than the long-run volume of trade. We have shown that a relative increase in the price of X will increase X more and reduce output of Y more in the long run than in the short run. Thus $A_L$ must be below and to the right of $A_S$. Because of the homogeneity of preferences the two consumption points must lie on the same line from the origin. These effects together imply that the short-run volume of trade will be larger than the long-run volume of trade.

The tariff revenues in the short run, $B_SC_S$, are significantly higher than the long-run tariff revenues, $B_LC_L$. If residents of other regions are able to share in these tariff revenues then there may be an incentive for other regions to encourage the imposition of tariffs on the imports of commodity X. These results give rise to Proposition 4.4.

## 3. INTERREGIONAL VS INTERNATIONAL TRADE

The relative long-run and short-run costs of the switch from international to interregional trade can easily be seen from Figure B.3. The interregional transportation cost is exactly equal to the tariff revenue collected from international trade and thus is equal to $B_SC_S$ in the short run and $B_LC_L$ in the long run.

The differences between the long-run and short-run costs of the unnecessary interregional transportation are striking. The short-run costs of the tariff are smaller than the long-run costs as long as the regions continue to trade with the rest of the world. In the short run the tariff moves us from C to $C_S$ while in the long run we move from C to $C_L$. However, if the tariff is sufficiently high to generate interregional trade then in the short run we move from $C_S$ to $B_S$ and in the long run from $C_L$ to $C_B$. The short-run welfare position with interregional trade is certainly the worst of the four possible equilibrium positions.

## 4. TAXES AND TRADE

Figure B.4 illustrates the imposition of a production tax on Y and a consumption tax on X for a region that is importing Y. The free-trade consumption and production points are C and A, and in the short run consumption moves to $C_S$ and production to $A_S$. In the long run consumption is at $C_L$ and production at $A_L$. In this case the short-run volume of trade

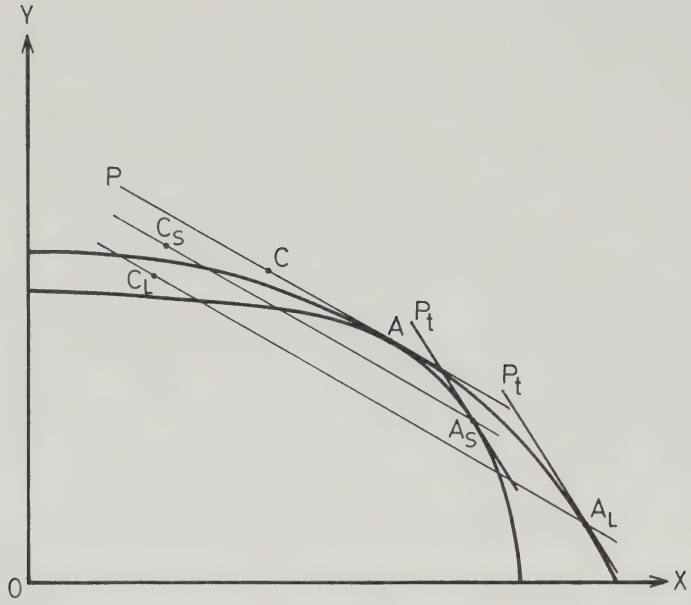


Figure B.4

is less than the long-run, in contrast to the situation with the tariff. It is clear that the short-run equilibrium in this situation lies intermediate between the two long-run equilibria.

Figure B.3 can be used to consider the same tax structure as illustrated in Figure B.4 for the region importing X. Pulling these two diagrams together, we note that in the initial free-trade situation the economy as a whole is a net importer of commodity X. In the short run with the tax structure the trade vectors for the two regions are the same length so that the economy as a whole is neither a net importer nor a net exporter of either commodity. In the long run the economy has become a net exporter of commodity X. Obviously the switch in trade patterns could occur either because of the short-run effects of the tax structure or because of the move from the short run to the long run.

## 5. REGIONAL ECONOMIC POLICY

Figure B.5 illustrates the construction of the short-run production possibility curves for the two regions. Region W

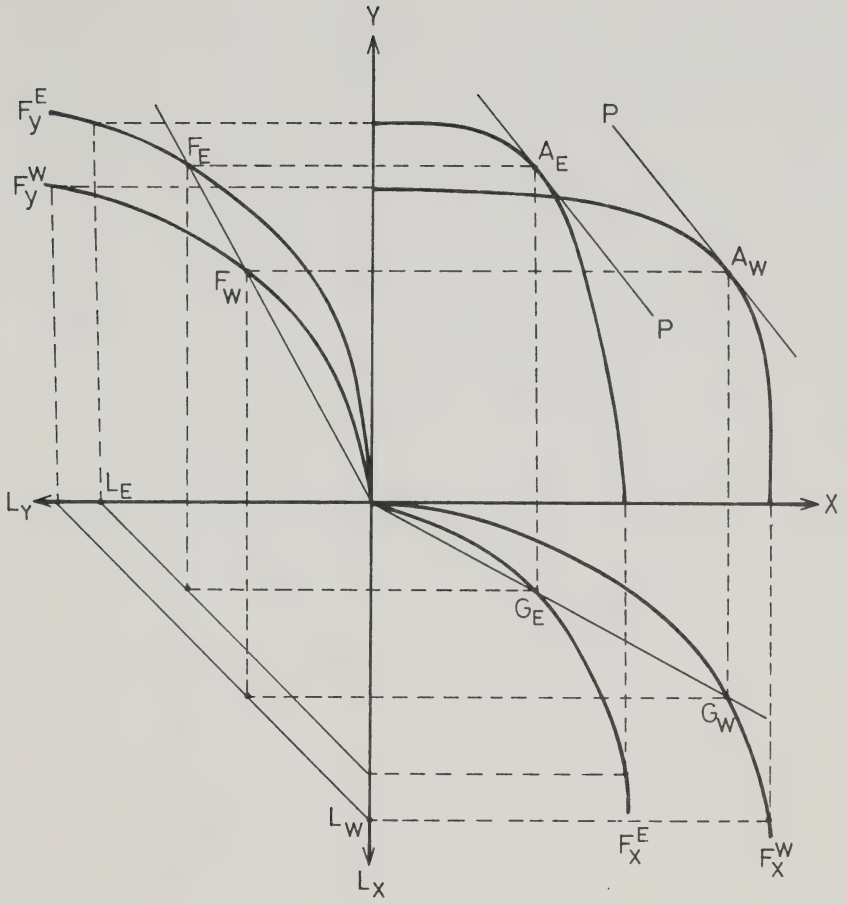


Figure B.5

is assumed to have more labour than region E and thus the labour constraint in quadrant 3 is farther from the origin. Region E has more capital than region W, but given that production functions in the two regions are identical and since both regions produce both commodities, region W will still allocate more capital to the production of X than will region E. This situation is indicated in quadrant 4.

Several interesting observations can be made about this figure. The production functions for both commodities have been assumed homogenous of degree 1, and therefore the total

product curves for any level of capital input are radial expansions of one another. Thus all total product curves have the same slope along any ray from the origin. In quadrant 2 the slopes of the total product curves for the two regions are the same at points $F_E$ and $F_W$. Recall that the slope of the total product curve is the marginal product of labour which in a competitive economy is the return to labour in the Y industry. The same is true for points $G_E$ and $G_W$ in quadrant 4. These four points generate the output points $A_E$ and $A_W$ in quadrant 1, which for prices P are the initial equilibrium points for the two regions. Thus this figure confirms the fact that at an initial long-run equilibrium with the same commodity prices in both regions and both regions producing both goods, the real and relative wage rates will be the same in both sectors and in both regions.

In Figure B.6 we concentrate attention on the return to labour by constructing, for the same equilibrium shown in Figure B.5, the marginal product curves associated with the total product curves. Quadrant 3, showing the total supply of labour in the two regions and the allocation of labour between the two industries in both regions, is identical with that of the preceding figure. Thus points $F_E$ and $F_W$, for example, represent exactly the same labour input to the Y industry in the two regions as in Figure B.5. The Y axis now measures the marginal product of labour in the Y industries rather than total output as it did in Figure B.5. Similarly for the X industry. Point $B_y$ represents payments to labour in terms of Y, and because of the assumption that both regions are initially in equilibrium with the same factor prices, $B_y$ will be the same for both region E and region W. Similarly $B_x$ represents the payments to labour for both regions in terms of commodity X. Note that the line $B_yB_x$ is just the price line P from Figure B.5. $B_yB_x$ also represents the budget constraint for an individual worker, and the equilibrium consumption point for a representative worker can be found by locating point C where this budget constraint is tangent to the highest indifference curve.

Now consider an increase in the relative price of Y, and for the moment assume that this price change takes place only in region E. In Figure B.5 this price change would result in an increase in the output of Y and a reduction in the output of X and a corresponding transfer of labour from X to Y. From Figure B.6 it can be seen that the result will be a reduction in the marginal product of labour in the Y

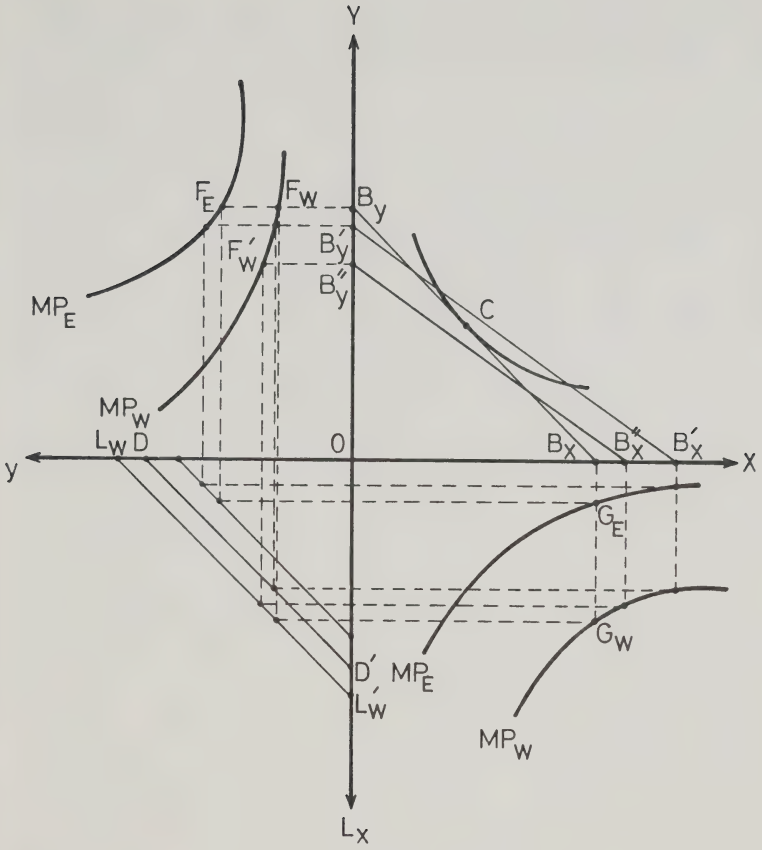


Figure B.6

industry and an increase in the marginal product of labour in the X industry. The new budget constraint is then $B'_yB'_x$ in the first quadrant. As before, this budget constraint has the slope of the new price line and must necessarily intersect the original budget constraint $B_yB_x$. Whether this price change will make labour better or worse off depends on where the indifference curve is tangent to the budget line. In the particular situation shown, labour has been made better off by the increase in the price of Y. In particular, if preferences are sufficiently biased towards commodity Y whose price has risen then labour will be made worse off. If preferences are biased towards commodity X whose price has

fallen, labour will benefit by the price change. We therefore have the ambiguity concerning the effects of price changes on the return to labour discussed in the body of Chapter 4.

If we have no reason to expect a bias in tastes towards either commodity then there will be a presumption that, for region E, an increase in the price of Y will make labour better off. Region E produces a relatively large amount of Y and has a large amount of capital allocated to that industry. The amount of capital allocated to industry X is not only less than the amount allocated to industry Y but is even less than the amount allocated to the production of X in region W. The large amount of capital in the Y industry and the relatively small amount of capital in the X industry imply that the slope of the marginal product curve for Y will tend to be less than it is for industry X. We see in Figure B.6 that the shift of labour from industry X to industry Y has resulted in a relatively small reduction in the marginal product of labour in industry Y and a relatively large increase in the marginal product of labour in industry X. In other words, the intersection of the two budget lines tends to be towards the Y axis. The closer the intersection of the two budget lines is to the Y axis the more likely it is that labour will gain from an increase in the price of Y.

Now consider the same increase in the price of Y in region W. For small price changes, and given the fact that the marginal products of labour are identical in the two regions, we will observe the same reallocation of labour between the two industries as was found in region E. This change is shown in Figure B.6, where the new marginal product of labour in industry Y in region W is $F'_W$. Because region W has less capital allocated to the Y industry than does region E the marginal product of labour in the Y industry in region W is steeper, and thus the same reallocation of labour will result in a larger fall in the marginal product of labour in W than it does in E. By the same argument the marginal-product-of-labour curve in industry X is less steep in region W than it is in E, resulting in a smaller change in the marginal product of labour as more labour enters that industry. The net result is that the new budget line for industry W lies uniformly below that for region E. Of course, both these new budget lines must have the same slopes since both have a slope equal to the relative commodity price ratio.

It is also clear from Figure B.6 that labour in region W is worse off relative to the initial set of commodity prices. In other words, the relative increase in the price of Y has made labour worse off than it was previous to the price change and has also made labour worse off relative to workers in region E. And as before the welfare change for workers in region W associated with the price change is ambiguous. If tastes were sufficiently biased towards commodity X then workers could be better off with the relative increase in the price of Y.

A relative increase in the price of X can be analysed in exactly the same way. Because of the symmetry of the model the results can most easily be seen simply by switching the X and Y axes in Figure B.6 and relabelling the two sets of marginal product curves. It is then clear that the results are just the reverse of those found for an increase in the price of Y. An increase in the price of X will make labour in region W better off than labour in region E. Thus we have the results of Proposition 4.10.

The increase in the relative price of Y analysed in Figure B.6 has unambiguously made labour in region E better off than labour in region W. This difference in the regional wage rates will encourage interregional factor mobility and Figure B.6 can be used to show the amount of migration that will be required to equalize wage rates in the two regions. Consider the reduction in the labour supply that would be required in region W to equalize these wage rates under the assumption that the labour supply in region E remains the same. This is easily calculated by taking the value of the marginal product of labour in the Y industry for region E and equating it to the marginal product of labour in the Y industry in region W and doing the same for industry X. From the figure we can see that if the labour supply in W were the line DD' then W and E would have identical wage rates.

But the reduction in the labour supply implied by moving from $L_W L'_W$ to DD' is much larger than would be required, for we have not yet taken account of the reduction in wages in region E that would be necessitated by the inflow of labour from region W. Thus the labour mobility associated with DD' is approximately double what would be required for equilibrium. Note that the amount of interregional labour migration required would be of the same order of magnitude as the intersectoral movement of labour generated by the original price change.

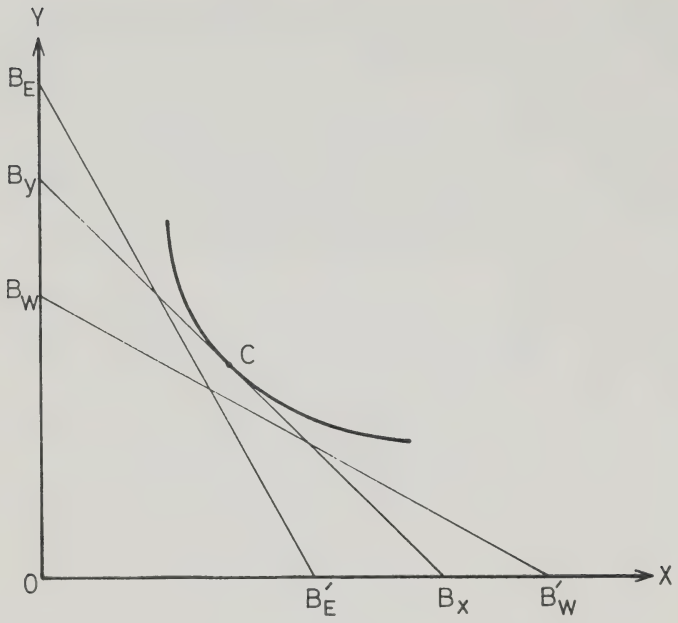


Figure B.7

We now consider the effect of a tariff on the return to labour. Figure B.7 reproduces the first quadrant of Figure B.6 with $B_yB_x$ the initial budget constraint for a representative consumer. Consumption is initially at point C, and we assume that we are in long-run equilibrium so that this is the equilibrium for both regions. Assume a tariff on commodity Y. Only region W will be affected, and from a production point of view a tariff is equivalent to a deterioration in the terms of trade. As we have seen this will result in a new budget constraint such as $B_WB'_W$. A tariff on commodity X will raise the relative price of X in region E and will result in a new budget constraint for consumers in that region of $B_EB'_E$. As the diagram has been constructed, tariffs on both commodities have made labour in both regions worse off.

Although there will be a presumption that tariffs will make labour worse off in both regions these results are by no means certain. For one thing it is clear from Figure B.7 that a change in the assumption about preferences could result in the tariff improving the welfare of labour.

Furthermore the shifts in the budget constraints depend not only on the production functions themselves but also on the endowments of capital and labour in the two regions. Thus while the situation of Figure B.7 is certainly a possibility it is not a necessary consequence of tariffs.

Finally note that with a tariff on both commodities there can, in general, be no presumption as to whether labour is better off in region E or in region W. With a tariff on only one commodity there is a presumption that labour will be worse off in the region importing that good and therefore a tendency for labour to leave that region. This movement of labour would continue until the budget lines in the two regions were both tangent to the same indifference curve. Note that the conditions for an equilibrium here are somewhat different than usually assumed. Equilibrium is achieved when the utility levels of the representative workers in the two regions are the same, which does not imply that wage rates are the same in the two regions.

## APPENDIX C

# Regional trade with increasing returns to scale

The production function for individual firms producing X and Y can be written:

(1) $X_i = (X^T)F_x(K_{ix},L_{ix})$,

(2) $Y_i = (Y^T)F_y(K_{iy},L_{iy})$, $0 < T < 1$,

where all firms in each industry are identical. The production functions $F_x$ and $F_y$ are assumed to be homogeneous of the first degree, that is to exhibit constant returns to scale, and T is assumed the same for both industries. While an increase in $X_i$ will increase $X = \Sigma X_i$ slightly, it is assumed that the change is too small to be noticed by the individual firm, and thus each firm ignores the effect of its own output on industry supply, and behaves as a perfectly competitive firm. Note that this is just a variant of the usual perfectly competitive assumption.

Summing over all firms in both industries we have:

(3) $X = \Sigma X_i = (X^T)\Sigma F_x(K_{ix},L_{ix}) = (X^T)F_x(K_x,L_x)$,

(4) $Y = \Sigma Y_i = (Y^T)\Sigma F_y(K_{iy},L_{iy}) = (Y^T)F_x(K_x,L_x)$.

The factor constraints are the usual ones:

(5) $K = K_x + L_y$,

(6) $L = L_x + K_y$.

Equations (3) and (4) can be rearranged with output on the left-hand side:

(7) $X = (F_x(K_x,L_x))^{T*}$,

(8) $Y = (F_y(K_y,L_y))^{T*}$,

where $T^* = 1/(1-T) > 1$.

Thus T* is the degree of homogeneity for the industry production function.

If one writes $F_{xL}$ and $F_{xK}$ for the first derivatives of $F_x$ with respect to labour and capital and similar notation for Y, and assumes that firms treat factor prices and industry output as parametric, the first-order conditions for profit maximization when both goods are produced are

(9) $w = P_x X^T F_{xL} = P_y Y^T F_{yL}$,

(10) $r = P_x X^T F_{xK} = P_y Y^T F_{yK}$.

Note that factor rewards depend on output levels.

## 1. INCREASING RETURNS TO SCALE IN BOTH INDUSTRIES

Figure C.1 is the factor-box diagram for a representative region. Since production functions are homogeneous the production contract curve will have the usual shape. As before, we have assumed that commodity X is labour-intensive. In autarky both commodities would be produced and equilibrium would be at a point such as A. Note that if the two regions have the same relative endowments of capital and labour and differ only in absolute size, then both could be represented by Figure C.1 with only a scale change being required. Furthermore if tastes are identical and homothetic

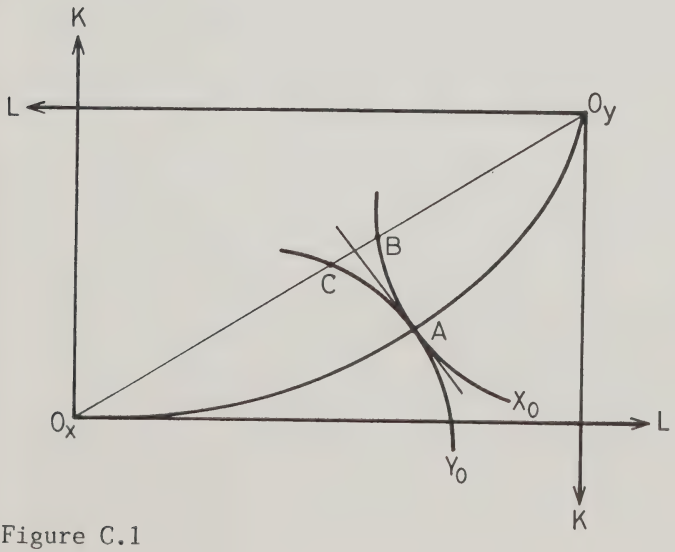


Figure C.1

in both regions then A would represent the autarky equilibrium point for both. Thus in autarky, even though the two regions are not the same size, relative factor prices will be equalized. As will subsequently be shown, however, absolute factor prices will differ.

Now suppose that both regions are allowed to trade and that, as in Figure 5.1, they specialize in different commodities. Thus one region will specialize in X and produce at point $O_y$ while the other region will specialize in Y and produce at $O_x$. The relative factor prices for both regions can be found from the slopes of the isoquants through the two origins of the factor box or, because of the assumption of homogeneity, from any isoquant for those same capital-labour ratios. Thus the slope of the X isoquant through $O_y$ is equal to the slope of $X_0$ at point B, and the slope of the Y isoquant through $O_x$ is equal to the slope of isoquant $Y_0$ at point C. Thus the slopes of the X and the Y isoquants at points B and C respectively give the relative factor prices in the two regions under the assumption that they specialize in different commodities.

Relative factor prices were equal at point A before trade, and trade has resulted in the relative factor rewards becoming different. Indeed, the slope of the X isoquant through $O_y$ (the slope of $X_0$ at B) is the steepest wage-rental ratio consistent with equilibrium for any point on the production contract curve. Similarly the slope of the Y isoquant at $O_x$ (the slope of $Y_0$ at point C) is the flattest wage-rental ratio consistent with the equilibrium in this factor box. Thus trade has resulted in the situation in which factor prices in the two regions are as far apart as is possible in equilibrium.

The effects of specialization on factor rewards and the resulting implications for factor mobility can be seen from equations (9) and (10). We see that factor rewards depend both on the first derivatives of the production function and on the level of output of the industry. Suppose first that the two regions differ significantly in size but are otherwise identical. Suppose both produce only commodity X in equilibrium. With the same price of X facing both regions and with the same production functions, the wage-rental ratio will be identical for the two regions, since the term $X^T$ in both equations (9) and (10) will cancel out. But while the wage-rental ratio will be identical the returns to factors will not, since these depend on the level of output of commodity X. In particular, both the return to

labour and the return to capital will be higher in the region that produces a larger amount of X. This result will lead to a movement of both labour and capital from the small region to the large region, and we have the results of Proposition 5.7.

With specialization in different commodities the results are less straightforward. First, as has been shown in Figure C.1, the wage-rental ratio in the two regions will differ. Marginal products will obviously differ since the two regions are producing different commodities, and real factor returns will therefore depend on the levels of outputs in the two regions. It is certainly possible that if one region is much larger than the other, output effects will dominate, resulting in the situation where both the wage rate and the return to capital are higher in the large region. As before this will result in the movement of both factors from the small to the large region, and we have Proposition 5.5.

Alternatively, if regions are approximately the same size it is possible that both the relative and real factor rewards will be higher in the region specializing in the commodity using that factor intensively. In this case with factor mobility labour will move to the region producing commodity X and capital will move to the region producing commodity Y. From equations (9) and (10), if these factor inflows reduce the first derivatives of the functions $F_X$ and $F_Y$ and if these reductions dominate output changes, then factor flows will equalize real and relative factor prices.

The possibility that these factor movements could result in welfare improvements for both regions quite distinct from the gains associated with specialization is shown in Figure C.2. Here the isoquants for both industries are plotted from the same origin, and for simplicity we have assumed that both regions have endowments A. This assumption is not crucial for the analysis. If we assume that region B specializes in X and region S in Y then the levels of outputs for regions B and S are $X_0$ and $Y_0$ respectively. Relative factor prices are equal to the slopes of the two isoquants at E and therefore clearly differ in the two regions.

We now suppose that real and relative factor-price differences between regions have the same sign, and that when factor mobility is allowed both factors move. While in general there can be no presumption as to the proportions in which factors will move, new factor allocations of $A_S$ and $A_B$ are clearly possible. Note that $A_SA$ and $A_BA$ must be identi-

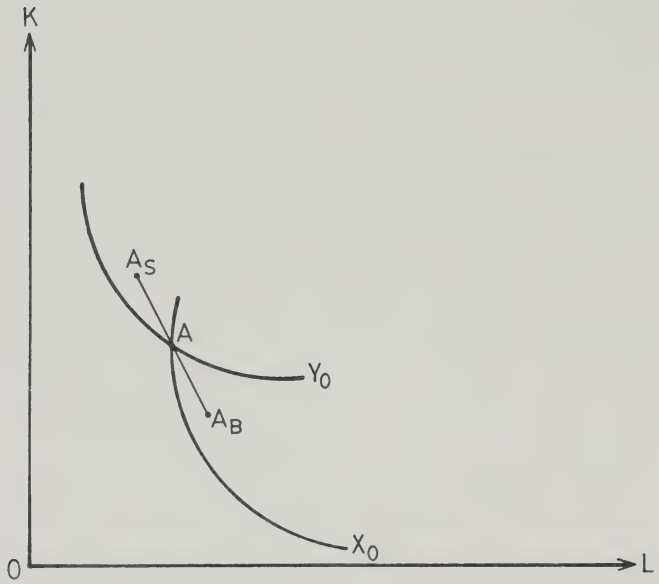


Figure C.2

cal in length, since the factors that leave one region must be the same as the factors that enter the other. If the points $A_S$ and $A_B$ represent a situation where both real and relative factor rewards in the two regions have been equalized, then this factor reallocation will have increased welfare in both regions. Clearly $A_S$ represents a higher output of Y than $Y_0$, and $A_B$ is on a higher X isoquant than $X_0$. Thus both regions have been made better off from the factor movements, and this gain is quite distinct from that associated with the original gains from trade.

The result that factor mobility is an independent source of gains for the two regions is, of course, a consequence of the assumption of increasing returns to scale. There are always gains to producing more, and the initial situation where factors of production exist in the same proportions in both regions is clearly not optimal if the two regions specialize in different goods. Shifts of factors to the region that produces the commodity in which that factor is intensive will clearly increase output, and for at least some factor movements both regions can produce more.

## 2. INCREASING RETURNS IN THE X INDUSTRY ONLY

We now assume that while there are increasing returns to scale in industry X, industry Y is characterized by constant returns to scale. Thus while both production functions are assumed to be homogeneous, Y is assumed to be homogeneous of degree 1 and X to be homogeneous of degree greater than 1. As before we assume that industry X is labour-intensive for all factor-price ratios. We also retain the assumption that the two regions differ in size but that they are endowed with capital and labour in exactly the same proportions.

Because production functions are homogeneous and identical across regions, and because endowments in the two regions are in the same proportions, the factor box of Figure C.3 can be used to represent both regions. The production contract curve $O_x A_S O_y$ will be identical for the two regions except for scale. It is clear from Figure 5.3 that region B will produce relatively more of commodity X, the industry in which there are increasing returns to scale (see also Markusen and Melvin 1981). Thus points $A_S$ and $A_B$ could represent the equilibrium production points for regions S and B

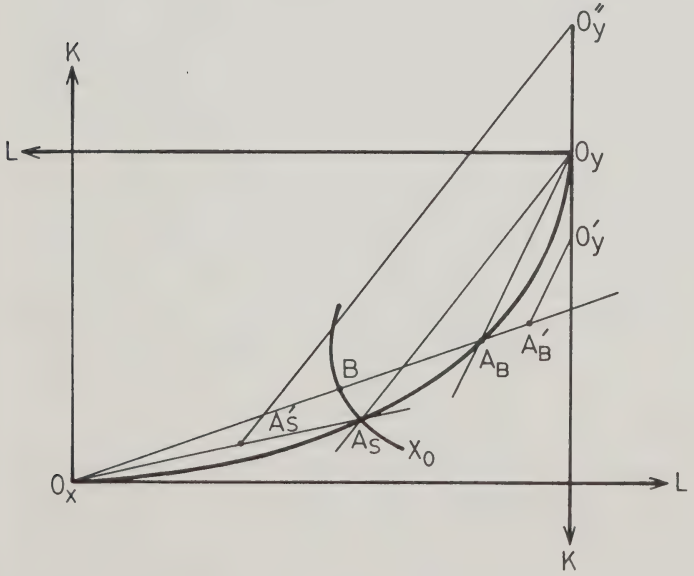


Figure C.3

respectively. As in Figure 5.3 we are assuming a trading equilibrium in which both regions face the same set of external commodity prices.

It is immediately clear that in the trading equilibrium the wage-rental ratio will be higher in region B than in S. Because of the assumption of homogeneity the slope of the isoquant through $A_B$ is equal to the slope of the isoquant $X_0$ at B, which is steeper than the slope of $X_0$ at $A_S$.

To determine the relationship between the real factor returns in the two regions consider equations (9) and (10). Recall first that because of constant returns to scale in industry Y the expression $X^T$ on the right-hand side of both of these equations reduces to 1. There is no ambiguity about the relative size of the real wage rate in the two regions for, first, the wage-rental ratio is higher in B and, second, because the output of X is larger in region B the term $X^T$ must also be larger. Thus the real wage rate is unambiguously higher in the large region.

Now consider the real return to capital. Because of constant returns to scale in industry Y it is known that the real return to capital is a decreasing function of the capital-labour ratio. This is a property of homogeneity of the first degree. In Figure C.3, with production at $A_B$ and $A_S$ for the large and small regions respectively, we see that the capital-labour ratio for B is larger than for S. Thus the real return to capital must be lower in B than in S. Note that this is exactly the argument used to prove the Stolper-Samuelson theorem.

The factor-price differences described above will generate factor movements between the two regions, and we would expect a movement of L from region S to region B, a movement of K from region B to region S, or both. We first consider the effects of capital mobility. In Figure C.3 the movement of capital from region B to region S will result in the new origin $O'_y$ for region B and the origin $O''_y$ for region S. Note that the distance $O_yO''_y$ is greater than the distance $O_yO'_y$ because the scale is different for the two regions, and thus the same actual movement of labour results in a smaller proportional change for region B than for region S. Because commodity prices are unchanged capital-labour ratios in both industries in both regions will also be unchanged, at least as long as both regions continue to produce both commodities. Thus the new equilibrium production points for the assumed capital flows will be $A'_B$ and $A'_S$ for regions B and S respectively. As is clear

from the figure, and as a consequence of the Rybczynski theorem, we see that the output of X is increased in region B and reduced in region S and that just the opposite has occurred for the output of industry Y. Note that the actual changes in output for the X industry are not proportional to distance in this figure because of increasing returns to scale in X.

Several conclusions can be drawn from Figure C.3. First, while the capital inflow to region S increases the productive capacity of this region and substantially increases the output of industry Y it results in a reduction in the output of commodity X, the increasing-returns-to-scale good. As has already been noted, reductions in the output of X are welfare-reducing. At the same time while the large region is losing capital it is nevertheless increasing the output of industry X and is therefore gaining from the capital mobility. It can also easily be shown that the volume of trade for both regions will increase because of this capital flow.

Had we considered labour mobility, exactly the same results would have been derived. A movement of labour into the large region will increase the output of X and the outflow of labour from the small region will correspondingly reduce X output. And, of course, if there is mobility of both factors exactly the same results follow. Thus the factor movements generated by the factor-price differentials associated with the trading equilibrium will necessarily be harmful to the small region and increase the welfare of the large region.

If factor movements continue then one or both regions will eventually become specialized, after which relative factor prices will adjust. For example, if region S becomes specialized in Y then further inflows of capital will reduce the real and relative returns to capital and increase the real and relative returns to labour, and factor prices could become the same for both regions.

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Ontario Economic Council Research Studies

# 32 The Interregional Effects of Canadian Tariffs and Transportation Policy

JAMES R. MELVIN

In a geographically dispersed country such as Canada, in which regions are distinguished resource bases, transport policies are a critical factor in economic development. In this study James Melvin considers the role of tariffs as they affect transportation costs within Canada.

Melvin proposes application of the two-country model of neoclassical trade to the interregional economic structure of Canada, taking into account the costs of internal transport. He applies this basic theoretical approach to a number of different problems: taxation, capital flows between regions, short-run factor immobility, and increasing returns to scale.

Melvin's findings indicate that tariffs induce resource waste by encouraging excessive internal transportation of goods between regions. He concludes with an assessment of policy implications for Ontario arising from his study.

JAMES R. MELVIN is a member of the Department of Economics at the University of Western Ontario.

University of Toronto Press ISBN 0-8020-6630-5